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U.S. Army Environmental Center

Riverbank Army Ammunition Plant (RBAAP)

Record of Decision

March 1994

U.S. ARMY ENVIRONMENTAL CENTER
Aberdeen Proving Ground
Maryland 21010-5401

U.S. ARMY INSTALLATION RESTORATION PROGRAM

DEFENSE ENVIRONMENTAL RESTORATION PROGRAM

RECORD OF DECISION

RIVERBANK ARMY AMMUNITION PLANT

MARCH 1994

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SECTION 1

DECLARATION OF THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

Riverbank Army Ammunition Plant
5300 Claus Road
Riverbank, California 95367-0670

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial actions for the Riverbank Army Ammunition Plant (RBAAP) in Riverbank, California, that were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)(CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site and has been made by the United States Environmental Protection Agency (EPA) in consultation with the California EPA - Department of Toxic Substances Control (DTSC), the California EPA-Central Valley Regional Water Quality Control Board (RWQCB), and the U.S. Army.

1.3 ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

1.4 DESCRIPTION OF THE SELECTED REMEDY

This sitewide ROD contains two response actions that address the media of concern at RBAAP. This ROD also documents the decision that no further action is warranted at the Evaporation/Percolation (E/P) ponds. The previous removal action, to remove zinc- and total petroleum hydrocarbon (TPH)-contaminated sediments, eliminated the need to conduct additional remedial actions. The two response actions for this ROD are a groundwater response action and a landfill response action. The overall site cleanup strategy combines these two remaining response actions with the previously conducted response actions described below. Each of these response actions was designed to be consistent with and contribute to the final remedial activities selected under this ROD:

- Interim Groundwater Treatment System (IGWTS) Response Action — The installation of this interim extraction and treatment system on-site serves to mitigate the groundwater contamination until the final groundwater remedy is implemented.

- Permanent Potable Water Supply (PPWS) Response Action — The PPWS provides residents with a public water supply for domestic use and limits use of the contaminated groundwater by off-site residents to irrigation. This removal action serves to eliminate exposure to the contaminated groundwater through ingestion and showering until the final groundwater remedy restores the aquifer to drinking water standards.

- Evaporation/Percolation (E/P) Ponds Zinc and Total Petroleum Hydrocarbon (TPH) Removal Action — This removal action removed soils at the RBAAP E/P ponds that were contaminated with zinc and TPH. This removal action was designed to remove sediments that were contaminated with zinc above the California hazardous waste criteria as defined under Title 22. The action also served to fully characterize the ponds, leading to the removal of several small areas contaminated with TPH. After the zinc and TPH removal, it was determined that no further remedial action was required for the E/P ponds.

  According to the E/P Ponds Characterization Report, no further action is deemed necessary at the E/P ponds based on water quality considerations. Groundwater monitoring will continue at the E/P ponds in accordance with applicable water discharge requirements. If any groundwater degradation becomes evident based on these monitoring activities, additional actions may be warranted.

Remediation levels were established for the groundwater and response action objectives for the landfill at RBAAP. Remedial objectives for the groundwater response were developed to prevent further degradation of the groundwater above applicable or relevant and appropriate requirement (ARAR)-based limits and to reduce risks to public health, welfare, and the environment. The remediation levels were established as the state Drinking Water Standard (DWS) maximum contaminant level (MCL) of 50 micrograms per liter (μg/L) for chromium and the federal and state DWS MCL of 200 μg/L for cyanide. The landfill response action objectives address the potential impact to groundwater from residual levels of chromium remaining in the landfill soils.

The selected groundwater remedy is Increased Extraction With Treatment at the Interim Groundwater Treatment System (IGWTS) and at the facility's Industrial Waste Treatment Plant (IWTP). The major components of the selected groundwater remedy include the following:

- Groundwater extraction from wells located on-site and off-site, with an estimated minimum extraction rate of 120 gallons per minute (gpm) (actual extraction and treatment rates necessary to fully capture the chromium and cyanide plumes will be designed into the system as determined during the remedial design effort). The extraction system will be designed to capture chromium plumes to 50 μg/L and cyanide plumes to 200 μg/L.

- Treatment for chromium and cyanide using chemical reduction/precipitation.

- Additional treatment for cyanide using ion exchange.

- Secondary treatment in the IWTP (flocculation and clarification).

- In accordance with the Dispute Resolution Agreement, field data and modeling will be used to aid in the design and optimization of the final groundwater extraction and treatment system to achieve full capture within 1 year of full system operation. Full plume capture will be demonstrated by an adequate monitor well network.

- Discharge of treated effluent to either the Oakdale Irrigation District (OID) Canal or the E/P ponds.

- Long-term groundwater monitoring for chromium and cyanide to monitor the effectiveness of the final extraction and treatment system in fully capturing the contaminated plumes and meeting the following effluent discharge limits: less than 50 μg/L for chromium and 5.2 μg/L for cyanide for the E/P ponds; less than 11 μg/L for chromium and 5.2 μg/L for cyanide for the OID canal.

The selected landfill remedy is a final cover for the landfill. The major components of the selected landfill remedy, as outlined in the Dispute Resolution Agreement (Appendix A), include the following:

- A foundation soil layer of sufficient stability will be provided by grading and compacting existing landfill soils.
- A 1-foot (ft)-thick clay layer will be installed consisting primarily of clays from a clean source on the installation. The clay source will be supplemented, as necessary, by off-site clays to produce a clay layer with a design permeability of 1 x 10^{-6} centimeters per second (cm/sec).
- Geotechnical data will be collected from a source at the installation to determine the appropriate ratio of on-site to off-site clays to achieve a design permeability of 1 x 10^{-6} cm/sec.
- A minimum of 1 ft of clean topsoil will be placed over the clay layer to provide an adequate rooting depth for vegetative cover and protection of the clay layer.
- The final cover will be designed with the objective of minimizing maintenance.
- The final cover will be graded to provide a minimum of 2% slope to minimize ponding of precipitation and provide adequate drainage.
- The final cover will be constructed in accordance with an approved Construction Quality Assurance Plan (CQAP).
- The final cover will be maintained to ensure its integrity for a period of 20 years.
- The 5-year review process under the RBAAP Federal Facilities Agreement (FFA) will be used to evaluate whether continued maintenance of the cover is necessary to protect human health and the environment, including water quality.

- One or two additional monitor wells will be installed at the point of compliance.

All activities required by this ROD will be carried out in accordance with procedures approved by EPA, CA EPA-DTSC, CA EPA-RWQCB, and the U.S. Army. Such activities will be consistent with all ARARs.

According to the water quality assessment conducted for the E/P ponds, no further action is deemed necessary at the ponds based on water quality considerations. Groundwater monitoring will continue at the E/P ponds in accordance with applicable waste discharge permits. If any groundwater degradation becomes evident based on these monitoring activities, additional actions may be warranted.

Activities may be necessary based on events that may occur after the approval and implementation of this ROD. The parties have agreed that these specifically include the recharging of the A aquifer zone (requiring additional investigation and remediation) and IWTP permitting (which may require additional investigation of the IWTP area under state RCRA requirements, remediation under the RCRA requirements, and a coordinated cleanup and abatement order issued by CA EPA-RWQCB, if warranted).

1.5 E/P PONDS DECLARATION STATEMENT

No further remedial action is necessary at the E/P ponds. The previous removal action eliminated the need to conduct additional remedial actions at the ponds. However, groundwater monitoring will continue under the NPDES permit for the ponds to verify that no unacceptable risks to human health, the environment, or water quality will occur in the future.

A 5-year review will be conducted to determine that the ponds continue to pose no risk to human health and/or the environment. A review of the groundwater monitoring data will be performed at this time.

1.6 STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost-effective. The remedies utilize permanent solutions. The groundwater remedy satisfies the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element. However, because treatment of the chromium contamination of the landfill was not found to be practical, the landfill remedy does not satisfy the statutory preference for treatment as a principal element. The nature of the soil contamination at the landfill precludes a remedy in which the contaminants could be excavated and treated in a cost-effective manner.

Because the remedial actions will result in groundwater contamination remaining above the remedial goals for the duration of the remedial effort, the Army will review the remedial actions no less than every 5 years after initiation of the remedial action. The 5-year review will ensure that the remedies continue to provide adequate protection of human health and the environment, including water quality. However, the Army has agreed to maintain the integrity of the final cover for a period of 20 years after its installation. Therefore, the Army has agreed to take the position that continued maintenance of the final cover for that 20-year period is necessary for the protection of human health and the environment, including water quality.

U.S. Army Installation Restoration Program

Record of Decision

Riverbank Army Ammunition Plant, California

John C. Wise	3-23-94
Deputy Regional Administrator	Date
U.S. Environmental Protection Agency	
Region IX	

Concurrence With:

U.S. Army Installation Restoration Program

Record of Decision

Riverbank Army Ammunition Plant, California

Anthony J. Landis for

3-24-94

Director
California EPA-Department of
Toxic Substances Control

Date

Concurrence With:

U.S. Army Installation Restoration Program

Record of Decision

Riverbank Army Ammunition Plant, California

William H. Crooks — 3-24-94

Executive Officer
California EPA-
Regional Water Quality Control Board

Date

Concurrence With:

U.S. Army Installation Restoration Program

Record of Decision

Riverbank Army Ammunition Plant, California

Lewis D. Walker

3/22/94

Lewis D. Walker
Deputy Assistant Secretary of the Army
Environment, Safety, and Occupational Health
Office of the Assistant Secretary
of the Army (I and L)

Date

SECTION 2
DECISION SUMMARY

The Decision Summary provides an overview of the problems posed by the conditions at the site, the remedial alternatives, and an analysis of those alternatives. This Decision Summary explains the rationale for the selection and how the selected remedy satisfies statutory requirements.

The background documents for the information contained in Subsections 2.1 through 2.18 are listed below:

- <u>RBAAP Remedial Investigation (RI) Report</u>, Volumes I and II, July 1991, Prepared by Roy F. Weston, Inc. (WESTON®) for the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA).
- <u>RBAAP Final Feasibility Study (FS) Report</u>, May 1993, as Amended by Revised Pages Dated July 1993, Prepared by WESTON for the U.S. Army Environmental Center (USAEC) (formerly USATHAMA).
- <u>RBAAP Proposed Plan</u>, August 1993, Prepared by WESTON for the USAEC.
- <u>RBAAP Engineering Evaluation/Cost Analysis (EE/CA) for the Evaporation/Percolation (E/P) Ponds</u>, May 1993 (Including Previous Addendum Dated November 1991), Prepared by WESTON for the USAEC.

2.1 NAME, LOCATION, AND DESCRIPTION

RBAAP is located at 5300 Claus Road, Riverbank, Stanislaus County, California, 1 mile south of the Stanislaus-San Joaquin County border and approximately 5 miles northeast of the City of Modesto (see Figure 2-1). The plant lies in a moderate climatologic region of the San Joaquin Valley in central California to the west of the Sierra Nevada Mountains. RBAAP is a government-owned, contractor-operated (GOCO) facility. The operating contractor at the facility is Norris Industries, Inc. (NI).

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MANAGERS DESIGNERS/CONSULTANTS

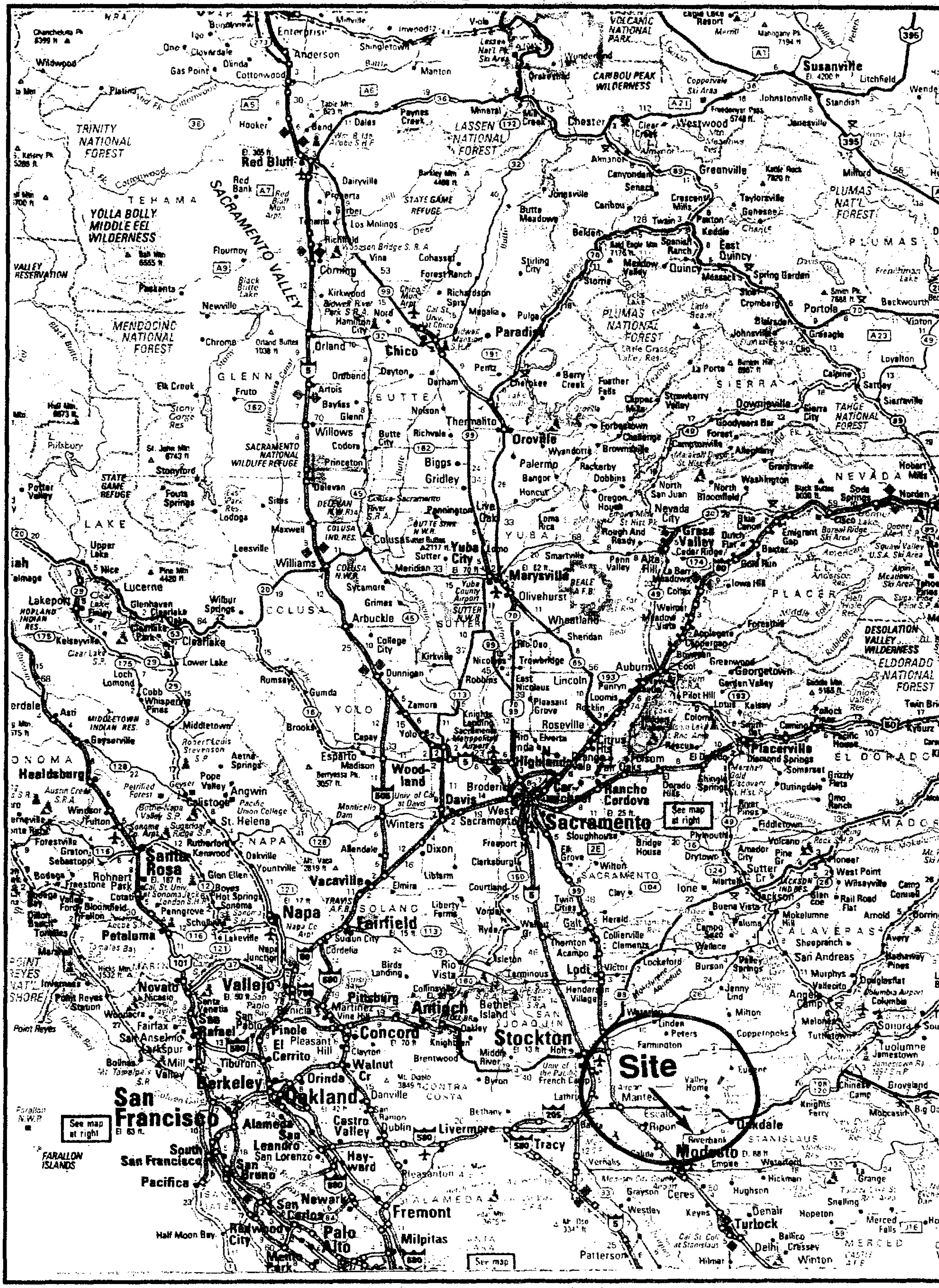

FIGURE 2-1 RBAAP GEOGRAPHIC LOCATION MAP

RBAAP occupies a total of 173 acres of land in a primarily rural area within Stanislaus County, California (see Figure 2-2). RBAAP land includes:

- 99 acres used for plant production.
- 37 acres used as pastureland.
- 27 acres occupied by the E/P ponds.
- 10 acres covered by roads, rights-of-way, and easements.

RBAAP is bordered on the north, west, and south by sparse residential areas, with the densest housing community lying west of the plant. RBAAP is bordered on the east by pastureland.

Major on-site features at RBAAP include (see Figure 2-3):

- The production area.
- The IWTP area.
- The landfill.
- A storage tank area.
- The sanitary sewage treatment ponds.
- The waste salt disposal pit.
- Two stormwater reservoirs.
- The E/P ponds (see Figure 2-2).

These features will be referenced throughout this document as either sources of contamination or landmarks to assist in the location of pertinent areas on-site.

RBAAP is situated between the Stanislaus River and Dry Creek on the northeastern side of the San Joaquin Valley. The site has minimal relief and slopes downward gently approximately 20 ft per mile towards the southwest. Based on the Riverbank 7.5 minute quadrangle map (U.S. Geological Survey (USGS), 1987), surface water on the southern end of RBAAP drains into a ditch that flows along the eastern and southern boundaries of RBAAP. This ditch then flows west along Claribel Road for approximately 1,000 ft past Claus Road, where it empties into a marsh that has formed behind the Modesto Main

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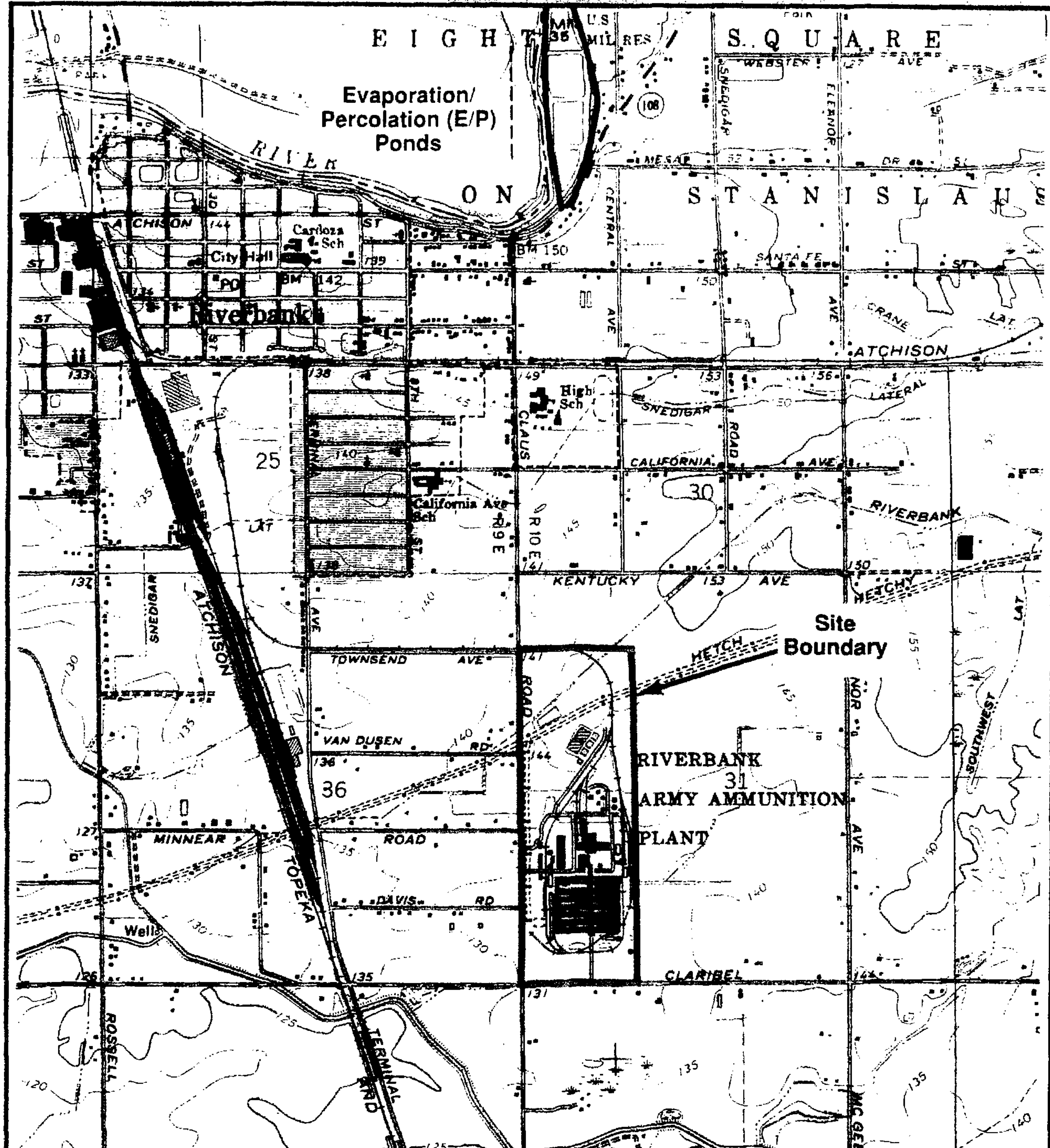
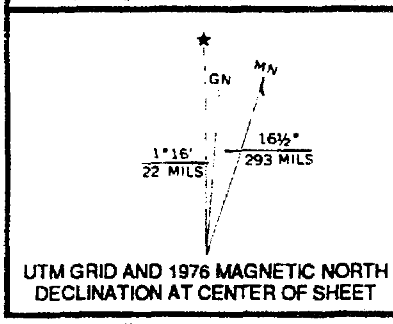




Riverbank Quadrangle
California
7.5 Minute Series (Topographic)

0 2000 4000

Scale in Feet

257-1901

FIGURE 2-2 LOCATION OF THE RBAAP AND THE EVAPORATION/PERCOLATION PONDS

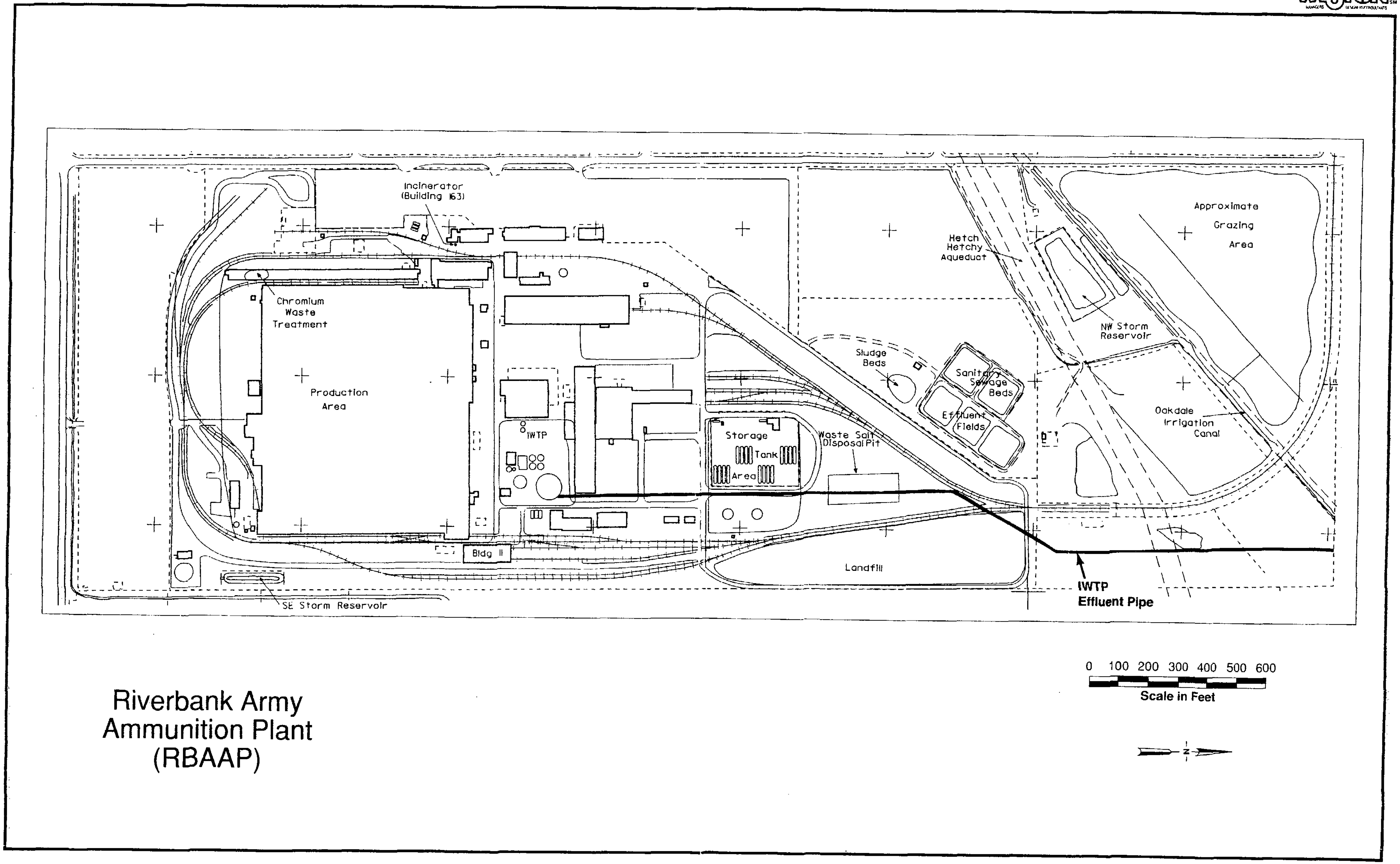


FIGURE 2-3 SITE LAYOUT - RIVERBANK ARMY AMMUNITION PLANT (RBAAP), RIVERBANK, CA

Canal. According to the Modesto Irrigation District (MID), water is pumped from the marsh into the Modesto Main Canal.

Surface water on the northern end of RBAAP drains into several drainage canals. These drainage canals appear to flow into the northwest storm reservoir and/or the OID Canal.

The area surrounding RBAAP is composed mainly of flood-irrigated pastures. These pastures have checks, or small ridges, designed to contain the irrigation water. As a result, there is minimal runoff from this area except during periods of heavy rainfall.

RBAAP is located in the northeastern side of the San Joaquin groundwater basin. The primary source of natural groundwater recharge to the basin occurs from direct precipitation and runoff infiltrating unconsolidated deposits in the Sierra Nevada foothills and high terraces east of the plant. Recharge from direct precipitation on the valley floor is limited by the high evapotranspiration rate and by the presence of hardpan in many of the native soils. The latter acts as a barrier to vertical infiltration.

An important secondary source of groundwater recharge in the region is from irrigation. In the Riverbank area, sources of irrigation water are primarily surface water reservoirs formed by the dams along a number of streams in the Sierra Nevada foothills to the east. Water from these sources is conveyed to the valley floor in spring, summer, and fall through natural and manmade channels (e.g., OID Canal, Modesto Main Canal), and is applied by flood-irrigation methods to the agricultural lands surrounding the plant.

According to Page and Balding, groundwater sources are used primarily to supplement the irrigation water supplied by canals, especially in dry years. Infiltration rates in the area are relatively slow, and some water-logging of soils occurs due to the presence of hardpan layers in the shallow soil. Groundwater levels in the area fluctuate seasonally in response to irrigation pumping patterns in the valley. Static water levels generally peak in the spring and reach a low in the fall.

The regional direction of groundwater flow into the eastern San Joaquin Valley is to the west. Under natural conditions, groundwater flows toward the San Joaquin River (and its major tributaries and the delta) and discharges as seepage to streams and as evapotranspiration from valley-bottom marshes. The Stanislaus River north of RBAAP also acts as a groundwater discharge area (California Department of Water Resources (CDWR), 1987). In addition, a regional pumping center around Modesto acts as a groundwater discharge zone and significantly influences the direction of groundwater flow in the Riverbank area by creating an apparent groundwater divide through the southern portion of the RBAAP site.

Five discrete sandy aquifer zones have been identified beneath RBAAP: the A, A′, B, C, and D aquifer zones.

The A aquifer zone remains designated as the uppermost laterally extensive sand unit on the site. The A aquifer zone is currently unsaturated (dry).

The A′ aquifer zone is also a laterally extensive sand unit. The A′ aquifer zone is partially saturated and monitor wells in this zone generally have screened intervals of 10 ft. The A′ aquifer zone is highly transmissive in some wells (MW-68A′), while in other wells the aquifer zone produced little water (MW-45A′), which indicates a variation in the hydraulic characteristics of the zone.

The bottom of the A′ aquifer zone appears to be, in some cases, indistinct from the top of the B aquifer zone. In these cases, there was no significant clay layer encountered beneath the bottom of the A′ aquifer zone screened interval. In certain instances, a few feet of interlayered sand and silt, but little or no clay, separated the A′ and B aquifer zones, suggesting at best a zone of decreased hydraulic connectivity between the A′ and B aquifer zones, rather than actual hydraulic separation. (In these cases, the B aquifer zone screened interval was identified by reviewing the lithologic and electric logs of the nearest existing B aquifer zone wells.)

The fine-grained and thinly interbedded I unit, as defined in the cross sections and on the sediment distribution maps, generally occurs between the A′ aquifer zone and the C aquifer zone. Monitor wells MW-101B, MW-102B, MW-66B, and MW-45B are completed within this interval as B aquifer zone wells. The I unit predominates in the northern part of the site and appears to be laterally continuous east-to-west across the site. The I unit interfingers laterally to the south with clay and silt zones, although the actual transition boundaries may be indistinct, and in some cases arbitrary, due to the large distances between data points (wells).

The C aquifer zone consists of sand that is generally laterally continuous across the site and is overlain and underlain by fine-grained sediments. The C aquifer zone has a distinctive resistivity and log signature with a well-defined upper and lower boundary, as seen in both the lithologic and geophysical logs. The lower boundary consists of pink-colored clay that may be characterized as one of the most consistent stratigraphic horizons across the site.

Because of the D aquifer zone thickness (approximately 45 ft) and the consistent overlying and underlying clay zones (present in all six D aquifer zone wells), the D aquifer zone is interpreted to be a hydraulically separate and laterally continuous unit beneath the site. This aquifer zone contains some of the coarsest sediments encountered on the site (clasps up to 3 inches in diameter in MW-67D) and also contains a high proportion of distinctive volcanic material. The D aquifer zone is interpreted to be highly permeable. An 11.5-ft-thick (average) fine aquifer zone, interpreted from the geophysical logs, appears in all six D aquifer zone wells in the middle of the gravel zone at an average depth of 209 ft below ground surface (bgs). The unit beneath the lower portion of the D aquifer zone was logged as clayey sandy gravel and is interpreted to have a lower permeability. This aquifer unit has been tapped by replacement domestic water supply wells at five locations within the residential area west of RBAAP.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

RBAAP was originally constructed by ALCOA as an aluminum reduction plant supplying the military. The plant was built under the authority of the Defense Plant Corporation. Construction began on 26 June 1942. The plant, which started production on 18 May 1943, was designed to produce 40,000 tons of aluminum per year. Because of the reduced need for aluminum metal by the military in World War II, the plant was closed by order of the War Production Board on 7 August 1944.

During the period of operation by ALCOA, cyanide wastes were generated and reportedly disposed of in a landfill in the northeastern portion of the Main Plant Area (see Figure 2-3). Disposal operations during this time period were reportedly limited to surface storage in the southern portion of the landfill.

After 7 August 1944 the plant was used for the storage of a variety of government surplus materials, including corn and grain. Early in 1949 the title was transferred from the Defense Plant Corporation to the Federal Works Administration. In 1951 a decision was made by the Ordnance Corps to convert to the manufacture of steel cartridge cases for joint Army and Navy use. The Riverbank Plant was assigned to the Army on 1 June 1951. The Norris Thermador Corporation of Los Angeles, California, was awarded a contract for the conversion and operation of RBAAP. The contract was executed on 30 January 1952.

Manufacturing Lines 1, 2, 3, and 4 produced 105-millimeter (mm) cartridge cases; Lines 5 and 6 produced the 3-inch/59, 5-inch/38, and 5-inch/54 naval cartridge cases; and Line 7 supplied additional quantities of 105-mm cases. One week after the completion of a preliminary lot on 17 September 1952, full production began and continued until May 1954, when the plant was placed on a limited production schedule. However, the manufacture of 105-mm cartridge cases continued until 1958. Full production ceased following the Korean Conflict and the plant was placed on a layaway status from 1958 until 1963. The plant, unsuccessfully marketed by the General Services Administration (GSA), was withdrawn from the sales market and placed on standby status until 1966. A decision was then made to reactivate the facility based on the support requirements of the Vietnam Conflict.

A contract was issued on 30 June 1966 to Norris Thermador Corporation (later changed to Norris Industries, Inc.) by the U.S. Army Ammunition Procurement and Supply Agency (APSA). This contract provided for: 1) the reactivation of existing facilities to produce 105-mm cartridge cases; and 2) the acquisition and installation of necessary facilities to concurrently produce 60-mm and 81-mm mortar projectiles. The final production contract for 81-mm projectiles and 105-mm cartridge cases was completed in September 1975. In 1977 a grenade production contract was awarded to RBAAP. The grenade production and mortar projectile lines were in operation from 1977 until 1990. In June 1990 the grenade production contract ceased. Currently, RBAAP activities are limited to the operation of the mortar production line, layaway of idle facilities, limited manufacturing and technology updates, and maintenance and protection of the overall plant.

Numerous investigations have been conducted at RBAAP. Since 1984, the investigations have been conducted with oversight from EPA Region IX, CA EPA-DTSC, and CA EPA-RWQCB. The investigations are summarized as follows:

- Installation Assessment - In January 1980 USATHAMA published an Installation Assessment that identified potential sites at RBAAP that may potentially contain hazardous materials.

- Contamination Survey: Exploratory and Confirmatory Phases - A Contamination Survey, conducted in three phases between June 1984 and July 1986, was performed by Envirodyne Engineers, Inc. (EEI) at RBAAP. The survey included landfill soil sampling, aquifer testing, monitor well installation, groundwater sampling, stratigraphic investigation, borehole geophysics, and ground-penetrating radar (GPR) surveying.

  The Contamination Survey concluded that only two contaminants, chromium and cyanide, were found in the groundwater at levels well above background values. Chromium was detected in excess of the DWS MCL of 50 μg/L on-site and off-site, and cyanide was detected in excess of the MCL of 200 μg/L on-site. The groundwater was determined to be flowing generally to the west, and the contaminants were gradually migrating deeper in the aquifer. The survey also determined that the IWTP area was a major source of chromium contamination and a minor source of cyanide contamination, and that the landfill was a major source of cyanide contamination at the site.

- Phase I RI Program - WESTON conducted the Phase I RI program between January 1987 and November 1988. The Phase I RI program focused on confirming and updating the results of the Contamination Survey. Activities included potential source area sampling and more extensive groundwater sampling both on-site and off-site.

  The Phase I RI program concluded that the chromium concentrations in the groundwater were primarily in the hexavalent chromium form, and that cyanide concentrations were primarily in the free cyanide form. The contaminant plume migration in the four aquifer zones (A, A′, B, and C) was found to be toward the west-northwest. Limited hydraulic connection between the four aquifer zones was determined, with a slight vertical downward gradient. In addition, the A aquifer zone was observed to have receded.

  Test pits and soil sampling determined that soils in the IWTP area and in the northern portion of the landfill exceeded background values for 10 analytes, but were not considered hazardous. Further investigation was warranted in the southern portion of the landfill.

- Phase II RI Program - WESTON conducted the Phase II RI program at RBAAP from May through August 1990. The Phase II RI program activities included further sampling of source areas, the installation and sampling of monitor wells and soil borings, groundwater sampling both on-site and off-site, and the performance of a groundwater recharge and discharge survey.

  The Phase II RI program concluded that the chromium and cyanide plumes were progressing off-site, and that a vertical gradient exists between the aquifer zones. No organic contamination was evident in the groundwater at RBAAP.

  Cyanide contamination was determined to be present in the soil above the hardpan in the southern portion of the landfill. Pot liner material, which is a K088-listed waste under RCRA, was also found scattered throughout the southern portion of the landfill.

- Risk Assessment (RA) - A RA was conducted to estimate the risk posed to human health and the environment by the contaminants of concern should the site remain in its current state with no remediation. The RA is comprised of a toxicity assessment, an exposure assessment, and a health risk evaluation for the groundwater at RBAAP. The purpose of these tasks is to estimate human exposure concentrations for current and future land use scenarios and to determine the potential health risks.

The quantitative risk characterization determined that no adverse noncarcinogenic risks are likely to occur from the groundwater based upon the measures that the Army has taken to monitor the public water supply and to provide a replacement potable water supply, as necessary. Currently, residential wells are monitored quarterly, and the construction and hookup of a permanent potable water supply to the residences has been performed. However, the risk characterization did determine that contaminant concentrations in the groundwater above the federal MCLs would be likely to cause adverse noncarcinogenic effects in the hypothetical situation where ingestion of contaminated groundwater were to occur over an extended period of time.

For the hypothetical future land use scenario, adverse noncarcinogenic effects from the ingestion of groundwater from the B and C aquifer zones are unlikely to occur for on-site workers. However, it should be noted that RBAAP obtains water from a deeper, uncontaminated aquifer at the site, and does not use groundwater from the contaminated aquifers. Noncarcinogenic risks associated with exposure to cyanide via inhalation while showering may potentially occur from use of the B aquifer zone groundwater. For on-site residents, total lifetime cancer risks associated with the use of on-site groundwater are low. However, adverse noncarcinogenic effects may occur by showering with groundwater from the A′ and B aquifer zones.

The RA Addendum indicated that the Hazard Index (HI) for the residential soil ingestion and dermal absorption exposure was 1.1, indicating that adverse noncarcinogenic effects are unlikely to occur. The total lifetime cancer risk associated with incidental ingestion and dermal absorption of chemicals in surface soils by hypothetical future on-site residents is 1×10^{-4} and 5×10^{-5}, respectively, based on the presence of arsenic in the soils. However, this risk may be overestimated by a factor of 10 due to an uncertainty in the slope factor. EPA is currently reviewing the potential changes to the slope factor.

- RI Addendum - WESTON conducted additional sampling under the RI program at RBAAP in September 1991. The RI Addendum activities included surface and subsurface soil sampling at the landfill, at the IWTP area, and at the sanitary sewage sludge drying beds. An addendum to the RA was also performed focusing on a future on-site residential scenario at RBAAP relating to soils.

The results of the additional sampling indicated concentrations of cyanide in the surface and shallow subsurface soils in the southern portion of the landfill. Total chromium concentrations in subsurface soil samples were within background levels for the site. However, the composite surface soil samples indicated chromium concentrations up to 90.6 milligrams per kilogram (mg/kg). Samples taken in the IWTP area and in the sludge drying beds indicated concentrations of chromium and cyanide within background levels at the site.

2.3 RESPONSE ACTIONS AND SOLID WASTE MANAGEMENT UNITS (SWMUs)

This section describes the previous response (removal) actions conducted at the site and discusses the SWMUs identified at RBAAP. The previous response actions conducted at RBAAP include the following:

- E/P ponds removal action.
- PPWS response action.
- IGWTS response actions.

Each of these response actions were conducted to assist in the overall cleanup strategy at the site. The response actions were preceded by EE/CA studies, which justify the response actions at the site (as required by the NCP). The response actions are outlined in Subsections 2.3.1 through 2.3.3.

The SWMUs are areas that previously or currently contain or manage solid waste at RBAAP. The SWMUs are described in Subsections 2.3.4 through 2.3.14.

2.3.1 Evaporation/Percolation (E/P) Ponds Removal Action

A removal action was required at the E/P ponds due to zinc contamination in the soils of the ponds. A brief description of the site history, investigations, and removal action activities is provided below.

The E/P ponds were constructed in 1952 for the disposal of treated effluent generated by RBAAP. The four unlined ponds are located approximately 1.5 miles north of the RBAAP boundary on 27 acres of land along the Stanislaus River. The treated effluent from the RBAAP IWTP is discharged through a force main to a point where it travels by gravity through a 21-inch vitreous clay pipe for a distance of approximately 1.5 miles prior to emptying into the ponds. The effluent is then distributed to the four ponds. Berm heights were raised in late 1972 to increase the capacity of the ponds, and the existing baffles were reconstructed with native soils. The ponds are operated independently based on the volume of flow that requires containment. The flow is diverted into a second pond once the first becomes full and so forth. The effluent discharged to the ponds evaporates and/or percolates through the existing sediments to the groundwater, thereby precipitating sediments into the bottom of the ponds. Data gathered from five monitor wells installed in the E/P ponds area indicate that the groundwater flows southwesterly toward the river.

The characterization work conducted at the E/P ponds has identified the pond sediments as the area of concern. Based upon the ARARs assessment, specific areas of the E/P ponds sediments contain levels of zinc that exceed the California Total Threshold Limit Concentration (TTLC) value of 5,000 mg/kg for zinc, thus classifying this material as a hazardous waste. Therefore, removal action alternatives were developed and analyzed to satisfy the California TTLC criteria by removal of the sediments with elevated zinc concentrations.

An EE/CA of removal action alternatives was prepared for the E/P ponds at RBAAP (WESTON, 1993a) and reflects the results of the characterization work at the ponds. As a result of the analysis of removal action alternatives, and following public review and comment on the EE/CA, Alternative 2: Excavation and Off-Site Disposal, was selected for implementation at the E/P ponds from three alternatives: 1) On-Site Sediment Extraction; 2) Excavation and Off-Site Disposal; and 3) Excavation and Soil Amendment Application.

The selection of this alternative was based on the following:

- This alternative actively remediates the sediments in the E/P ponds in a cost-effective manner. While Alternative 3: Soil Amendment Application, is the most cost-effective alternative, the sediments will continue to be considered hazardous, and it is not expected that landowners will accept the application of hazardous waste onto their land.

- The remedial action objectives will be met.

- The alternative can be readily implemented since it uses conventional excavation and disposal methods.

- An ecological assessment of the ponds concluded that the elevated levels of zinc pose a very low potential environmental risk to ecological receptors (flora and fauna) in the area. A zinc removal action would mitigate these risks.

In order to address the concerns of RWQCB regarding additional characterization of the unsaturated zone and groundwater, the Army conducted additional characterization activities at the E/P ponds. The purposes of these activities were as follows:

- Zinc characterization to delineate the areal and vertical extent of excavation required for the removal of zinc-contaminated soils.

- Pond characterization to determine: 1) the potential presence of additional chemicals of concern at the site; and 2) the potential impact of soil contamination on human health and the environment (including groundwater beneath the site). The pond characterization involved subsurface soil sampling and monitor well sampling.

For the zinc characterization activity, a total of 20 borings was installed and samples from these borings were analyzed for total extractable zinc. The boring locations (including rationale) are provided in the RBAAP E/P Ponds Characterization Plan.

This additional characterization was detailed in the E/P Ponds Characterization Report dated September 1993. The results of this characterization program indicated that zinc was the contaminant of concern at the E/P ponds, namely in Pond 3. In addition, minor total petroleum hydrocarbon (TPH) contamination was detected. No other chemicals were identified as presenting a potential impact to human health or the environment at the ponds.

The zinc removal action in Pond 3 was carried out during the period of 23 September 1993 through 30 December 1993. A total of 1,118.5 cubic yards (yd^3) of contaminated soil was excavated and disposed of in an approved off-site landfill. Pond 3 was then regraded with existing pond soils.

Confirmatory sampling activities, which were conducted during the removal process, indicated that remaining soils did not exceed criteria; therefore, the removal action was considered complete. An exception to this is the limited elevated TPH contamination detected during the sampling activities. Under oversight by the regulatory agencies, the Army also excavated the limited areas of TPH contamination and disposed of the soil with the zinc-contaminated soils.

Based on a water quality site assessment using data generated during the E/P ponds characterization, it is the state's position that a number of constituents may present a threat to water quality. However, contaminant concentrations decrease significantly 2 ft bgs and the quarterly groundwater monitoring indicates no current impact to water quality.

As indicated in comments made by the regulatory agencies and discussed during project manager meetings, the Army will continue to monitor the groundwater at the E/P ponds as part of this ROD. No further remedial action is proposed at the E/P ponds based upon the results of the investigations.

2.3.2 Permanent Potable Water Supply (PPWS) Response Action

A response action was deemed necessary at RBAAP due to the principal threats to residents from chromium and cyanide groundwater contamination migrating downgradient of RBAAP. An EE/CA report was prepared to identify and evaluate corrective or removal action alternatives that provide a PPWS to residences adjacent to RBAAP that may be affected by groundwater contamination from the facility.

Five possible actions were evaluated:

- City of Riverbank water supply.
- No action.
- Bottled water.
- Residential well replacement.
- RBAAP well water supply.

The removal action alternative recommended in the EE/CA involved extending the existing public water supply system of the City of Riverbank to service the properties in the affected area.

The EE/CA report, entitled RBAAP Permanent Potable Water Supply (PPWS) Engineering Evaluation/Cost Analysis (EE/CA), May 1991, was approved by the regulatory agencies and supported by the public based on comments received during the public comment period.

The PPWS system was designed and constructed by the U.S. Army Corps of Engineers (USACE), Sacramento District and the City of Riverbank. The residents were connected to the City of Riverbank public water supply in December 1992.

The Army will continue to monitor residential wells within the plume boundaries that continue to be used for irrigation and livestock watering. This monitoring program will serve to protect the livestock and crops that receive groundwater from the affected aquifer zones through the residential wells. If analytical results indicate that livestock or crops may be affected by the groundwater, the residents and regulatory agencies will be immediately notified.

2.3.3 Interim Groundwater Treatment System (IGWTS) Response Action

The IGWTS response action was established at the RBAAP facility as a non-time-critical removal action to protect public health, welfare, and the environment and to mitigate further contamination off-site. The IGWTS was deemed necessary due to groundwater containing levels of chromium above the MCL of 50 μg/L off-site and a cyanide plume extending toward the western boundary of the site.

The EE/CA Report for the IGWTS Removal Action Selection at RBAAP (Bechtel, November 1989) evaluated several removal actions and selected one that would protect human health and the environment, attain applicable or relevant and appropriate federal and state requirements, and provide cost-effectiveness compared to the other alternatives examined. The removal action was selected to satisfy the statutory preference for treatment that reduces toxicity, mobility, or volume as a principal element.

As a result of this evaluation and the support of the public, as determined during the public comment period, the selected removal action consists of extraction of on-site contaminated groundwater in the B and C aquifer zones, treatment of the extracted water to a target level of 20 $\mu g/L$ for both chromium and cyanide, pumping the treated water to the existing IWTP for secondary treatment, and final disposal in the E/P ponds. Extraction wells drawing from the B and C aquifer zones are expected to induce downward movement of contaminated groundwater from the A′ aquifer zone due to the degree of hydraulic interconnection between these zones. The extraction wells being utilized are monitor wells MW-45B, MW-45C, MW-47B, MW-47C, MW-52B, MW-52C, MW-54B, and MW-54C.

The treatment alternative selected consists of reduction/precipitation for chromium and cyanide removal followed by selective anion exchange for additional cyanide removal.

This treatment system was approved by the regulatory agencies, and the IGWTS was fully operational by October 1991. After the IGWTS went through 1 month of trial operation, the completed system was accepted for operation by NI at the end of October 1991.

2.3.4 Industrial Waste Treatment Plant (IWTP) Area

The IWTP serves as treatment for all industrial wastewater streams generated by production activities at RBAAP. The primary treatment technologies are flocculation and clarification. At present, treated effluent is discharged to the E/P ponds.

The IWTP Area is regulated under RCRA and has a Part B permit (EPA I.D. Number CA7210020759). Since the area is regulated under RCRA, it will eventually undergo RCRA closure when operations cease at the facility. Because these regulations will apply upon closure and the IWTP is currently in operation, remedial actions for soils at the IWTP will not be considered at this time. Further characterization of IWTP soils may be warranted under RCRA upon closure of the treatment plant. However, it should be noted that sampling results from the RI did not indicate concentrations of inorganics above background levels at the IWTP Area; therefore, a remedial action is not warranted at this time.

A discussion of post-ROD activities related to the IWTP area is provided in Subsection 2.19.

2.3.5 Sanitary Sewage Beds

The Sanitary Sewage Beds were investigated during the RI addendum sampling program. Since results of this sampling effort did not indicate concentrations of chromium or cyanide above background levels at RBAAP, a remedial action is not warranted for the sanitary sewage beds.

2.3.6 Empty Drum Storage Area

The Empty Drum Storage Area, also known as the Rail Car Off-Loading Area, was investigated during the RI and the RI addendum sampling programs in conjunction with the IWTP Area. Results of soil sampling in the area did not indicate concentrations of chromium or cyanide above background levels at RBAAP. The results of the soil gas survey indicated that it was unlikely that any sources of organic contamination exist in the area. Based on the sampling results, a remedial action is not warranted for the Empty Drum Storage Area.

2.3.7 IWTP Effluent Sewer Line Break

The IWTP Effluent Sewer Line Break, which occurred in 1972 near the Hetch-Hetchy Aqueduct, was investigated during the RI sampling programs. The sampling results did not indicate the presence of elevated levels of inorganics. Therefore, a remedial action is not warranted in the area of the IWTP Effluent Sewer Line Break.

2.3.8 Industrial Waste Pipe Leak

An Industrial Waste Pipe Leak was discovered at the beginning of WESTON Phase II RI activities. A sampling program was initiated, and sample results did not indicate the presence of elevated levels of inorganics. Therefore, a remedial action is not warranted in the area of the Industrial Waste Pipe Leak.

2.3.9 Waste Salt Disposal Pit

The Waste Salt Disposal Pit was designated as a SWMU due to a reference in the Installation Assessment that stated that the Waste Salt Disposal Pit was used to desiccate sludge from the IWTP in 1975. Although the pit was constructed, it was never used for this or any other purpose. Therefore, a remedial action is not warranted in the area of the Waste Salt Disposal Pit.

2.3.10 Northwest Stormwater Reservoir

The Northwest Stormwater Reservoir was investigated during the RI sampling programs. Two samples were obtained from the outfall of the reservoir, and the results did not indicate concentrations of cyanide at levels greater than three times above background levels. Concentrations of chromium in the Northwest Stormwater Reservoir were greater than two times background levels. However, the soil concentrations were evaluated during the RA and the FS, and no remedial action was warranted based on the evaluations.

2.3.11 Southwest Stormwater Reservoir

The Southwest Stormwater Reservoir was investigated during the RI sampling programs. One sample was obtained near the outfall of the reservoir. Results of the sampling did not indicate concentrations of chromium and cyanide above background levels for the site. Based on these data, a remedial action is not warranted for the Southwest Stormwater Reservoir.

2.3.12 Hazardous Waste Storage Area

The Hazardous Waste Storage Area is regulated under RCRA and has a Part B permit (EPA I.D. Number CA7210020759). Since the area is regulated under RCRA, it will eventually undergo RCRA closure when operations cease at the facility. Therefore, no action will be performed in the Hazardous Waste Storage Area at this time.

2.3.13 Pesticide Storage Area

The Pesticide Storage Area was used for the storage and mixing of pesticide solutions at the site. The pesticides were mixed with water in the storage building prior to use. A concrete sump was constructed in the late 1970s to collect any spillage from the pesticide/water mixing. In 1982, the sump was taken off-line and any spillage from mixing after this date would be discharged into the sanitary sewer system. Documentation of the history of the Pesticide Storage Area activities at RBAAP is provided in Appendix B.

No spills were reported while the concrete sump was on-line, and there is no evidence that any pesticide spills have occurred at the site. Therefore, no action will be performed in the Pesticide Storage Area. Closure of the Pesticide Storage Area will be regulated under RCRA closure requirements. Any investigation and/or remediation will be conducted to meet all state and federal requirements.

2.3.14 Underground Storage Tanks (USTs)

Several USTs exist at the facility. Two of the USTs were used for fuel storage and the rest were product storage tanks. The USACE, Huntsville District conducted a study in September 1989 entitled "RBAAP Investigation and Evaluation of Underground Storage Tanks." Currently, the USTs at RBAAP are being investigated by the USACE, Sacramento District under oversight by Stanislaus County. The county is responsible for the regulation of UST permitting, inspection, and removal. Remediation activities are regulated by CA EPA-RWQCB. Since the USTs at RBAAP are maintained and regulated under a separate program and no leaks have been found, no actions are warranted for the USTs under the CERCLA program. Any remedial actions associated with the USTs will be addressed by CA EPA-RWQCB under the authority contained in California Water Code Sections 13267 and 13304 and Title 23, California Code of Regulations, Division 3, Chapter 16.

2.4 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Compliance with the public participation requirements of CERCLA/SARA (Sections 113(K)(2)(B)(i-v) and 117) has been achieved for RBAAP. Details of community involvement throughout the RBAAP IR Program are discussed in Subsection 3.2 of this document (the Responsiveness Summary). The FS and the Proposed Plan were released to the public on 27 August 1993. The public comment period started on 27 August 1993 and ended on 27 September 1993. These and other documents pertaining to environmental investigations at RBAAP were made available to the public in both the Administrative Record and the information repositories at the following locations:

- RBAAP Visitor Lobby area.
- Stanislaus County Public Library - Riverbank Branch.
- Stanislaus County Public Library - Central Modesto Branch.

The notice of availability of these documents was published in the Riverbank News and the Modesto Bee on 27 August 1993. A public meeting was held on 31 August 1993 to inform the public of the preferred alternatives and to seek public comments. At this meeting, representatives from RBAAP, USAEC, EPA, DTSC, and RWQCB answered questions about the site and the remedial alternatives under consideration. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD.

This decision document presents the selected remedial actions for RBAAP, chosen in accordance with CERCLA, as amended by SARA, and, to the extent practical, the NCP. The decision for this site is based on the Administrative Record. The public will be notified of the availability of the ROD through a news release, and will be kept informed of all remedial actions through fact sheets and/or news releases.

2.5 SCOPE AND ROLE OF THE RESPONSE ACTION FOR RBAAP

The overall cleanup strategy for this sitewide ROD encompasses response actions that have previously been conducted at RBAAP and the response actions still required to remediate the principal threats to human health and the environment at the site. As presented in Subsection 2.3, the following response actions have previously been conducted:

- E/P ponds removal action.
- PPWS response action.
- IGWTS response action.

However, problem areas remain at RBAAP. As a result, two response actions will be addressed in this ROD, as discussed in the following subsections.

2.5.1 Groundwater Response Action

This response action addresses the contaminated groundwater beneath the site and in the off-site residential area to the west of the site. The contaminated groundwater is a principal threat at the site because of direct ingestion and showering of drinking water from wells that contain contaminants above state and federal ARARs. The purpose of this response action is to reduce migration of the groundwater contaminants, to restore the groundwater quality to remediation goals, and to meet ARARs.

2.5.2 Landfill Soils Response Action

This response action addresses the landfill soils, which require action as agreed to under the RBAAP Dispute Resolution Agreement (Appendix A). This agreement requires the installation of a final cover over the landfill to prevent the potential migration of chromium from the landfill soils to the groundwater. The levels of chromium remaining in the landfill soils are too low to feasibly remove and treat. This action also addresses potential risks associated with elevated levels of arsenic in the landfill soils under a hypothetical future residential use of the site.

2.5.3 E/P Ponds

No further action is warranted at the E/P ponds under CERCLA, based on the conclusion that the sediments remaining after the zinc and TPH removal actions pose no threat to human health or the environment. Groundwater monitoring will continue at the E/P ponds in accordance with applicable waste discharge permits. If any groundwater degradation becomes evident based on these monitoring activities, additional actions will be warranted.

Based on a water quality site assessment using data from the E/P ponds characterization, it is the state's position that a number of constituents may present a threat to water quality. However, contaminant concentrations decrease significantly 2 ft bgs and the quarterly groundwater monitoring indicates no current impact to water quality.

2.6 ARARs

The federal and state ARARs that are applicable or relevant and appropriate to the response actions at RBAAP (with the following qualifications) are presented in Tables 2-1 and 2-2. Table 2-1 presents the specific ARARs that pertain to groundwater treatment at RBAAP, whereas Table 2-2 presents the specific requirements that pertain to remediation of the landfill at RBAAP. The state has asserted that Title 23 of CCR, Division 3, Chapter 15 (Chapter 15) is an ARAR for the landfill and groundwater response actions, and that the National Pollutant Discharge Elimination System (NPDES) permit for the discharge of treated groundwater is not subject to CERCLA. All parties to the ROD have not agreed that Chapter 15 is an ARAR and that the NPDES permit is not subject to CERCLA. In order to be protective of human health and the environment, however, all parties have agreed to apply the substantive provisions of Chapter 15 and the NPDES requirements as set forth below and in Tables 2-1 and 2-2. In so doing, the parties to the ROD are expressly

Table 2-1

ARARs for the Groundwater Treatment at RBAAP

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Construction of Extraction and Monitor Wells	The construction of all extraction and monitor wells must comply with California Well Standards construction requirements.	Construction of extraction and monitor wells		California Well Standards, Bulletin 74-81 and 74-90 - **Applicable**	
Groundwater Extraction	The groundwater will be extracted and treated until the aquifer meets federal and state MCLs and state Water Quality Objectives (WQOs) for protection of the beneficial use classifications for municipal, domestic, industrial, and agricultural water supply: • Chromium - 50 μg/L (CA MCL; CA WQO). • Cyanide - 200 μg/L (Safe Drinking Water Act (SDWA) MCL).		57 FR 31776 (17 July 1992, effective 17 January 1994), to be codified at SDWA 40 CFR, Part 141 - **Relevant and appropriate** 40 CFR 300.430(c)(2)(i)(B) - **Applicable**	Title 22, CCR[a] Chapter 15, §§ 64401 et seq. - **Applicable** California RWQCB Title 23, CCR Chapter 23 §3000 (California Inland Surface Waters Plan - Basin Plan 5B) State Board Resolution 88-63 State Board Resolution 68-16 - **Applicable** Pursuant to the agreement set out in text accompanying this ARAR table, substantive provisions of Article 5 contained in the sections of Chapter 15 listed below are to be followed - Title 23, CCR, Division 3, Chapter 15, Sections 2550.1, 2550.5 - 2550.10, and 2550.12	Porter - Cologne Water Quality Control Act (PCWQCA) Sections 13164, 13170, 13240, and 13241 PCWQCA Sections 13140 and 13240 PCWQCA Sections 13140 and 13240

Table 2-1

ARARs for the Groundwater Treatment at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Groundwater Treatment at the IGWTS and IWTP With Direct Discharge of Treatment System Effluent to the OID Canal	Must take action to protect affected fish or wildlife resources of the Stanislaus River - **Applicable**.	Point source discharge to waters of the United States - protection of downstream water - Stanislaus River	Fish and Wildlife Coordination Act (16 USC 661 et seq.); 40 CFR 6.302(g) - **Applicable**		
	National Pollutant Discharge Elimination System (NPDES) Permitting Program (with respect to chromium and cyanide).		40 CFR 122.44(a) (CWA) - **Applicable**	Title 23, CCR Chapter 9, Article 3 (Substantive requirements with respect to discharge of chromium and cyanide to be followed by agreement as stated in the text accompanying this ARARs table.)	
	Use of best available technology economically achievable (BATEA) is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis.				
	The discharge must comply with applicable federal Water Quality Criteria (WQC) and California WQOs for the protection of human health and aquatic organisms specified for the use classifications for the Stanislaus River:				
	E/P ponds: • Chromium (VI) less than 50 $\mu g/L$ (monthly average) • Cyanide - 5.2 $\mu g/L$ (monthly average)		CWA Sections 303(c)(2)(B) and 304(a) - **Relevant and appropriate**	• State Board Resolution 68-16	PCWQCA Sections 13164, 13170, 13240, and 13241
	OID Canal: • Chromium (VI) - 11 $\mu g/L$ (CA WQO for the protection of aquatic life - 4-day average concentration not to be exceeded more than once every 3 years ; 1-hour average 16 $\mu g/L$).				PCWQCA Sections 13140 and 13240

Table 2-1

ARARs for the Groundwater Treatment at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Groundwater Treatment at the IGWTS and IWTP With Direct Discharge of Treatment System Effluent to the OID Canal (continued)	The discharge must be consistent with the requirements of a Water Quality Management Plan approved by EPA under the Clean Water Act (CWA) §208(b).		40 CFR 122.44(d) - **Applicable**		
	Discharge limitations must be established for all toxic pollutants that are or may be discharged at levels greater than that which can be achieved by technology-based standards.		40 CFR 122.44(e) - **Applicable**		
	Develop and implement a best management practice (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters.		40 CFR 125.100 - **Applicable**		
	Criteria and standards for NPDES permit.		40 CFR 125 - **Applicable**		

Table 2-1

ARARs for the Groundwater Treatment at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Groundwater Treatment at the IGWTS and IWTP With Direct Discharge of Treatment System Effluent to the OID Canal (continued)	The BMP program must: • Establish specific procedures for the control of toxic and hazardous pollutant spills. • Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure. • Ensure proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA.	Discharge to waters of the United States	40 CFR 125.104 - **Applicable**		
	To ensure compliance, the discharge must be monitored for: • The mass of each pollutant. • The volume of effluent. • Frequency of discharge and other measurements, as appropriate.		40 CFR 122.44(i) - **Applicable**		
	Approved test methods must be followed for monitored waste constituents. Detailed requirements for analytical procedures and quality control (QC) are provided.		40 CFR 136.1-136.3(e) - **Applicable**		
	Comply with additional permit conditions such as: • Duty to mitigate any adverse effects of any discharge. • Proper operations and maintenance (O&M) of treatment systems.	Off-site discharges	40 CFR 122.41(d,e) - **Applicable**		

Table 2-1

ARARs for the Groundwater Treatment at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Groundwater Treatment at the IGWTS and IWTP With Discharge to the E/P Ponds	- **Applicable.**				
	The discharge must comply with applicable federal Water Quality Criteria (WQC) and California WQOs for the protection of human health and aquatic organisms specified for the use classifications for the *Stanislaus River:* E/P ponds: • Chromium (VI) less than 50 $\mu g/L$ (monthly average) • Cyanide - 5.2 $\mu g/L$ (monthly average) OID Canal: • Chromium (VI) - 11 $\mu g/L$ (CA WQO for the protection of aquatic life - 4-day average concentration not to be exceeded more than once every 3 years ; 1-hour average 16 $\mu g/L$). • Cyanide - 5.2 $\mu g/L$ (CA WQO for the protection of aquatic life - daily average; 1-hour average 22 $\mu g/L$).		*CWA Sections 303(c)(2)* (B) and 304(a) - **Relevant and appropriate**	• State Board Resolution 68-16	PCWQCA Sections 13164, 13170, 13240, and 13241 PCWQCA Sections 13140 and 13240

Table 2-1

ARARs for the Groundwater Treatment at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Groundwater Treatment at the IGWTS and IWTP With Discharge to the E/P Ponds (Continued)	Must take action to conserve threatened species; must not destroy or adversely modify the critical habitat of the valley elderberry longhorn beetle (Desmocerus californicus dimorphus); consultation with the Department of Interior (DOI).	Critical habitat upon which a federally threatened species depends	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR 402; Fish and Wildlife Coordination Act (16 USC 661 et seq.); and 33 CFR 320-330 - **Applicable**		
Disposal of Treatment Residuals	Hazardous waste that is transported off-site for disposal must be received by a hazardous waste facility that has an appropriate and valid Hazardous Waste Facility Permit or that is otherwise authorized by the State Department of Health Services.	Off-site disposal of hazardous waste		Title 22, CCR* Division 4.5, Chapter 13, §66263.23(b) - **Applicable if the treatment residues are hazardous waste and they are disposed of off-site.**	
	Waste must be packaged and transported according to RCRA, Department of Transportation (DOT), and Department of California Highway Patrol requirements.	Transportation of hazardous waste across public highways	40 CFR 262; 49 CFR 175, 178, and 179 - **Applicable if the treatment residues are hazardous waste and they are disposed of off-site.**	Title 22, CCR* Division 4.5, Chapter 13, §66263.23(b) - **Applicable if the treatment residues are hazardous waste and they are disposed of off-site.**	

Note:

*CCR = California Code of Regulations.

Table 2-2

ARARs for Remediation of the Landfill at RBAAP

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Fugitive Dust Emissions During Excavation and Grading	Application of water, chemicals, or vegetation to control dust emissions. Prevent or expeditiously remove any visible accumulation of mud or dirt from public paved roads, including shoulders, adjacent to the site of the landfill.	Fugitive emissions from construction, demolition, excavation, land clearing, grading, land leveling, cut and fill operations, travel on the site, and travel on access roads to and from the site Landfill disposal site		Rule 8020; Rule 8040; and Rule 8060 - **Applicable**	
Final Cover	Placement of a cover over waste. Pursuant to the Dispute Resolution Agreement reached during negotiations on 11 February 1993, the final cover of the landfill must include: • A foundation soil layer of sufficient stability provided by grading and compacting existing landfill soils.	Closure of any landfill		**Substantive provisions of Articles 5 and 8 of Chapter 15 are to be followed as set out in the Dispute Resolution Agreement (Appendix A).**	PCWQCA Section 13172

Table 2-2

ARARs for Remediation of the Landfill at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Final Cover (continued)	• A 1-ft-thick clay layer consisting primarily of clays from a clean source on the installation. The clay source will be supplemented, as necessary, by off-site clays to produce a clay layer with a design permeability of 1 x 10^{-6} cm/sec. • Geotechnical data collected from a source at the installation to determine the appropriate ratio of on-site to off-site clays to achieve a design permeability of 1 x 10^{-6} cm/sec. • A minimum of 1 ft of clean topsoil placed over the clay layer to provide an adequate rooting depth for vegetative cover and protection of the clay layer. • The final cover designed with the objective of minimizing maintenance.				

Table 2-2

ARARs for Remediation of the Landfill at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Final Cover (continued)	• The final cover graded to provide a minimum of 2% slope to minimize ponding of precipitation and provide adequate drainage. • The final cover constructed in accordance with an approved Construction Quality Assurance Plan (CQAP).				
Post-Closure Maintenance	Restrict post-closure use of property as necessary to prevent damage to the cover.	Final closure of a hazardous waste landfill with some hazardous materials or residues left in-place		**Substantive provisions of Articles 5 and 8 of Chapter 15 are to be followed as set out in the Dispute *Resolution* Agreement (Appendix A).**	PCWQCA - Section 13172
	Post-closure maintenance shall extend as long as wastes pose a threat to water quality.	Post-closure maintenance requirements for landfills in California		**Substantive provisions of Articles 5 and 8 of Chapter 15 are to be followed as set out in the Dispute Resolution Agreement (Appendix A).**	

Table 2-2

ARARs for Remediation of the Landfill at RBAAP (Continued)

Actions	Requirements	Prerequisites	Citation for Federal Requirements	Citation for California Requirements	Enabling Legislation for California Requirements
Post-Closure Maintenance (Continued)	Pursuant to the Dispute Resolution Agreement reached during negotiations on 11 February 1993, the following actions during post-closure maintenance must be taken: • The final cover will be maintained to ensure its integrity and effectiveness for a period of 20 years. • A 5-year review process under the RBAAP FFA will be used to evaluate whether continued maintenance of the cover is necessary to protect human health and the environment, including water quality after the 20-year maintenance period (refer to text in Subsection 2.6). • One or two additional monitor wells will be installed at the point of compliance to protect beneficial uses of the groundwater.				
Well Construction for Contained Groundwater Monitoring	The construction of all monitor wells must comply with California Well Standards construction requirements.	Construction of monitor wells		California Well Standards, Bulletin 74-81 and Bulletin 74-90 - **Applicable**	

not making a determination as to whether Chapter 15 is an ARAR or the NPDES permit is subject to CERCLA. The ARARs in Tables 2-1 and 2-2 will be used during the evaluation of alternatives and the discussion of statutory determinations in this ROD.

Additional qualifications include:

- The state expressed concerns with regard to the effectiveness of the IRM and the Army's data evaluation in a letter dated 25 August 1993. In order to address those concerns brought up by the state and to provide clarification to Sections 2 (f) and 2 (g) of the DRA, the Army has agreed to establish a groundwater monitoring program, pursuant to Title 23, Chapter 15, Article 5. The monitoring program will establish monitoring points that will act as points of compliance. These monitoring points will meet the substantive requirements of a detection monitoring, evaluation monitoring, and corrective action monitoring program pursuant to Title 23, Division 3, Chapter 15, Sections 2550.7 through 2550.10 and Section 2550.12.

- The effluent from the IWTP at RBAAP and the treated effluent from the IGWTS are commingled at RBAAP. The IWTP effluent is regulated by existing waste discharge requirements (WDRs) issued by the RWQCB. The discharge of the commingled treated groundwater will be governed by the same waste discharge requirements, which will be revised to include a NPDES permit. Therefore, the IGWTS effluent must comply with all conditions and requirements contained therein. Pursuant to Section 17.3 of the Federal Facilities Agreement (FFA) for RBAAP, the effluent requirements as set forth in Table 2-1 for chromium and cyanide will be included in the revised WDRs covering the discharge of the effluent.

2.7 SUMMARY OF SITE CHARACTERISTICS

2.7.1 Sources of Contamination

2.7.1.1 Landfill

The two primary sources of contamination on-site, which have been consistently identified by the site investigations, are the landfill and potentially the IWTP Area.

Historically, the term "landfill" has been used to describe the area noted in Figure 2-3. However, the entire area was not used for disposal activities. The disposal operations in this area did not involve typical landfill operations, but consisted of two discrete disposal trenches and a surface disturbance area, as described below. Therefore, the entire area is not a landfill. Nonetheless, the term "landfill" will be used throughout this report to avoid confusion with past historical references.

According to historical records, from 1942 to 1966 the landfill at RBAAP was used for the incineration and disposal of paper, dunnage, oils, greases, solvents, hospital wastes, construction debris, and industrial sludges. In 1966, on-site disposal operations were discontinued and the area was filled with dirt and construction rubble. In a series of aerial photographs interpreted by the Environmental Photographic Interpretative Center (EPIC), two trenches and one surface disturbance area were identified in the landfill. In the 1957 aerial photographs, a trench was noted in the northern end. In addition, in the 1963 aerial photograph a disturbed area was noted in the southern end of the landfill, and in the 1967 aerial photograph a new trench was noted in the central portion of the landfill. Further description of the landfill is provided in the WESTON RI/FS Technical Plan dated May 1987 (WESTON, 1987). These trenches and the landfill itself have been a focus of the site investigation at RBAAP.

2.7.1.2 IWTP Area

The IWTP at RBAAP was constructed to treat the wastewaters generated from the electroplating, cleaning, and metal finishing processes that are operated on-site. The IWTP includes facilities for flocculation, clarification, sludge thickening, sludge/liquid separation, and nitrate salt removal. The original storage and equalization tanks used for the IWTP were made of redwood. During periods of low flow to the IWTP the redwood would desiccate, causing gaps between the timbers. Upon filling, fluid would leak through the gaps to the ground until the timbers swelled, once again causing the gaps to close. From 1973 to 1980 the IWTP was upgraded and the redwood tanks were replaced with concrete tanks. The IWTP has been a focus of the site investigation activities at RBAAP.

Effluent from the IWTP is piped via an underground pipeline to the four ponds located along the Stanislaus River, approximately 1.5 miles north of the plant boundary (see Figure

2-2). The E/P ponds were constructed in 1952 for recharging groundwater via percolation. The industrial wastewater generated at RBAAP was disposed of by treatment (various techniques were used throughout the period of operation) and pumping to the E/P ponds. There was no outfall designed for these ponds. Disposition of the wastewater was strictly through evaporation and percolation.

In 1972 a pipe break occurred in the line connecting the IWTP with the E/P ponds. The break was not discovered for approximately 7 days. At that time, approximately 1 million gallons per day (mgd) (4,000,000 liters per day (L/day)) of effluent was being processed. The break occurred near the intersection of the effluent line with the Hetch-Hetchy Aqueduct (see Figure 2-3). The effluent line and the Hetch-Hetchy Aqueduct are closed-conduit lines; therefore, no interaction between the line and the conduit occurs.

RBAAP has always treated industrial wastewater prior to discharge into the E/P ponds. Before 1972 the pH of industrial wastewater was controlled by the addition of either sulfuric acid or aqueous ammonia. Although a "neutralized" effluent resulted from this procedure, contaminants such as iron, zinc, and chromium were precipitated as metal hydroxides and were eventually washed into the ponds. Moreover, this process allowed the release of dissolved and suspended solids, phosphates, and sulfates into the E/P ponds.

The IWTP, modified in 1972-1973, was designed for the precipitation and removal of contaminants from the industrial effluent. The plant was also designed with sufficient capacity to accommodate production requirements. In 1972-1973 treatment capabilities of the IWTP included:

- A lime addition facility for raising the pH to promote the formation of hydroxide flocculants.
- A facility for the addition of flocculation-aid (i.e., ferric chloride) to enhance settling.
- A clarifier for the removal of suspended solids.
- A thickener for concentrating the sludge from the clarifier.

- A centrifuge for final sludge/liquid separation.

- A reactor/clarifier for the treatment of phosphate solutions and soapy wash water, to which lime was added to achieve a pH >9.5.

- Nitrate salt equipment for treating the sodium nitrate-containing wash water generated by a heat treating process. The water was evaporated and the salts were recycled.

In September 1975 activities at the installation were reduced and, subsequently, the effluent discharge, which is regulated under a National Pollutant Discharge Elimination System (NPDES) permit, was reduced from a few million liters per day to approximately 10,000 L/day. Currently, the effluent discharged is approximately 2,000 L/day.

Prior to 1978 chromium wastes from a zinc chromate dip solution on the production lines did not receive special disposal treatment. These wastes were normally sent to the treatment plant and were pooled with other production wastewater solutions. After treatment with either ammonia or sulfuric acid for a pH adjustment between 6.5 and 8.5, the liquor was sent to the E/P ponds. In 1978 a batch chromium treatment system was installed. Sodium meta-bisulfite was used to reduce the chromium from a hexavalent to a trivalent state. Next, lime was added to raise the pH, and a polymer was added to promote the formation of a precipitate. The liquid was drained off and routed back to the IWTP and the solids were collected in barrels.

The open storage area, located adjacent to the northern end of Building 11 (see Figure 2-3), is also considered part of the IWTP Area. The area was historically used as a drum storage and rail car off-loading area, and was known to store drums of chromic acid. This area has been determined to be a source of chromium contamination. Soil borings were advanced in the area of the off-loading area near monitor well MW-17A to determine the potential presence of contamination in this area and to determine the source of high chromium levels in MW-17A. The results of this sampling are provided in the RI Addendum Report (WESTON, 1991b).

RBAAP was placed on the National Priorities List (NPL) in February 1990 due to groundwater contamination, and the environmental investigations at the site are governed by CERCLA.

2.7.2 Groundwater

2.7.2.1 Chromium Contamination

The four aquifer zones beneath the site and the off-site study area (A, A′, B, and C aquifer zones) have indicated levels of chromium greater the state MCL of 50 μg/L for chromium throughout the investigations at RBAAP. The A aquifer zone has since become dry in the region; therefore, the A′, B, and C aquifer zones are considered the areas of concern in the groundwater. However, as discussed in Subsection 2.19.1, the Army will continue to monitor A aquifer zone wells. If the A aquifer zone recharges, the zone will be investigated to define the extent of groundwater contamination, and if aquifer cleanup levels are exceeded, the groundwater extraction and treatment system will be expanded to remediate this aquifer zone.

Historically, data have shown that levels of chromium as high as 1,300 μg/L have been detected at the site. A summary of historical and current chromium concentrations in monitor wells at RBAAP is presented in Table 2-3.

Table 2-3 also provides chromium and cyanide concentrations in monitor wells for Quarter 3, 1993. These data indicate that currently there are four on-site monitor wells (EE-51, MW-52A, MW-54B, and MW-69A′) and four off-site monitor wells (MW-105B, MW-107A′, MW-107C, and MW-108B) with chromium concentrations exceeding the MCL of 50 μg/L. Isoconcentration contour maps of the chromium plumes in the A′, B, and C aquifer zones are presented in Figures 2-4, 2-5, and 2-6, respectively.

In addition to sampling for chromium and cyanide, select monitor wells surrounding the landfill and the E/P ponds monitor wells were sampled for other CA Title 22 list metals

Table 2-3
RBAAP Maximum/Minimum Chromium and Cyanide Concentrations During 1986-1993 Detected in Groundwater

MONITOR WELL	CHROMIUM		CYANIDE		QUARTER 3, 1993	
	MAX ug/L	MIN ug/L	MAX ug/L	MIN ug/L	Cr ug/L	CN ug/L
AEH1	13.0	ND	ND	ND	NS*	NS*
AEH2	ND	ND	5.0	ND	NS*	NS*
AEH3	6.0	ND	90.0	ND	NS*	NS*
AEH4	10.0	ND	**7,800**	**1,120**	NS*	NS*
AEH5	10.0	ND	**22,600**	**2,840**	NS*	NS*
MW5A'	ND	ND	ND	ND	ND	ND
MW5B	2.7	ND	3.4	ND	ND	ND
MW5C	6.4	ND	3.6	ND	ND	ND
AEH6	ND	ND	ND	ND	NS*	NS*
AEH7	ND	ND	12.0	ND	NS*	NS*
AEH8	ND	ND	ND	ND	NS*	NS*
AEH9	5.8	ND	ND	ND	NS*	NS*
AEH10	ND	ND	ND	ND	NS*	NS*
AEH11	ND	ND	ND	ND	NS*	NS*
NI12	10.2	ND	**2,450**	**365**	NS*	NS*
NI13	10.0	9.1	**4,130**	**975**	NS*	NS*
NI14	14.0	8.0	**3,900**	**2,900**	NS*	NS*
MW14A'	ND	ND	64.9	ND	ND	ND
MW14B	2.7	ND	2.6	ND	ND	ND
MW14C	11.3	ND	5.6	ND	ND	ND
NI15	23.0	ND	ND	ND	NS*	NS*
NI16	14.0	ND	18.6	10.3	NS*	NS*
NI17	**1,300**	**512**	31.6	ND	NS*	NS*
MW17A'	5.9	ND	3.3	ND	ND	ND
MW17B	6.9	ND	6.4	ND	ND	ND
MW17C	8.1	ND	12.7	ND	ND	ND
NI18	20.0	ND	21.0	ND	NS*	NS*
NI19	10.0	ND	19.0	ND	NS*	NS*
NI20	20.0	ND	**281**	26.6	NS*	NS*
NI21	**1,000**	**360**	**1,250**	**844**	NS*	NS*
NI22	11.2	ND	18.6	ND	NS*	NS*
NI23	ND	ND	ND	ND	NS*	NS*
NI24	ND	ND	ND	ND	NS*	NS*
NI25	7.0	ND	ND	ND	NS*	NS*

Table 2-3
RBAAP Maximum/Minimum Chromium and Cyanide Concentrations During 1986-1993 Detected in Groundwater (Continued)

MONITOR WELL	CHROMIUM		CYANIDE		QUARTER 3, 1993	
	MAX ug/L	MIN ug/L	MAX ug/L	MIN ug/L	Cr ug/L	CN ug/L
NI26	32.6	ND	ND	ND	NS*	NS*
NI27	ND	ND	12.2	12.2	NS*	NS*
NI28	ND	ND	ND	ND	NS*	NS*
NI29	ND	ND	15.3	15.3	NS*	NS*
NI30	10.7	ND	ND	ND	NS*	NS*
NI31	**100**	21.0	ND	ND	NS*	NS*
NI32	49.0	ND	ND	ND	NS*	NS*
NI33	**1,000**	ND	ND	ND	NS*	NS*
NI34	**60.7**	ND	ND	ND	NS*	NS*
MW34A'	**52.7**	31.4	23.5	ND	43.7 (41.4)	17.3 (ND)
MW34B	14.6	ND	99.4	ND	6.4	17.3
MW34C	5.7	ND	ND	ND	ND	ND
NI37	30.0	ND	ND	ND	NS*	NS*
NI38	10.0	ND	ND	ND	NS*	NS*
NI39	10.6	ND	ND	ND	NS*	NS*
NI40	30.0	ND	ND	ND	NS*	NS*
NI41	20.0	ND	ND	ND	NS*	NS*
MW45A	ND	ND	2.9	ND	NS*	NS*
MW45A'	41.3	ND	**690**	ND	36.3	ND
MW45B	7.7	ND	**1,075**	ND	ND	41.9
MW45C	12.3	ND	86.4	ND	ND	ND
EE46	32.4	14.0	69.8	19.2	18.6 (17.3)	58.9 (55.8)
MW47A	**75.2**	19.1	3.2	ND	19.1	ND
MW47B	33.1	ND	**592**	13.9	NS**	NS**
MW47C	34.0	ND	**229**	ND	5.2	18.4
EE49	**350**	**119**	7.0	ND	NS*	NS**
EE50	10.1	ND	ND	ND	NS*	NS*
EE51	**200**	**76.7**	3.9	ND	**114**	ND
MW52A	**520**	**180**	ND	ND	**285 (349)**	ND (ND)
MW52B	43.2	14.9	89.2	ND	30.1	44.7
MW52C	42.0	ND	24.1	ND	18.2	ND
MW54A	25.6	ND	ND	ND	11.7	ND
MW54B	**427**	3.4	19.3	ND	**427 (407)**	16.5 (16.2)
MW54C	21.1	10.5	9.5	ND	14.8	ND

Table 2-3
RBAAP Maximum/Minimum Chromium and Cyanide Concentrations During 1986-1993 Detected in Groundwater (Continued)

MONITOR WELL	CHROMIUM		CYANIDE		QUARTER 3, 1993	
	MAX ug/L	MIN ug/L	MAX ug/L	MIN ug/L	Cr ug/L	CN ug/L
EE55	3.7	ND	ND	ND	ND	ND
EE56	6.0	ND	37.3	ND	ND	37.3
EE57	6.3	ND	118	ND	ND	25.1
EE60	ND	ND	42.7	ND	NS*	NS*
MW61A	4.2	4.2	ND	ND	NS*	NS*
MW61A'	11.5	ND	ND	ND	ND	ND
MW61B	4.0	ND	3.8	ND	ND	ND
MW61C	5.8	ND	ND	ND	ND	ND
MW62A'	4.1	ND	179	ND	ND	30.9
MW62B	5.5	ND	4.9	ND	ND	ND
MW62C	8.4	ND	ND	ND	ND	ND
MW63A'	23.5	ND	**1,660**	8.0	ND (ND)	**789** (733)
MW64A'	28.1	ND	25.3	ND	5.6	ND
MW65A'	**110**	ND	19.2	ND	12.5	ND
MW66A'	**67.0**	9.6	4.6	ND	14.0	ND
MW66B	34.4	8.0	3.6	ND	13.7	ND
MW66C	10.1	ND	ND	ND	ND	ND
MW67D	15.4	ND	ND	ND	8.5	ND
MW68A'	ND	ND	ND	ND	ND	ND
MW68B	ND	ND	ND	ND	ND	ND
MW68C	8.2	ND	16.0	ND	ND	ND
MW69A'	**312**	39.4	21.3	ND	**175** (159)	ND (ND)
MW101A'	3.7	ND	26.0	ND	ND	ND
MW101B	ND	ND	21.7	ND	ND	ND
MW101C	6.0	ND	3.7	ND	ND	ND
MW102A'	4.4	4.4	2.8	2.8	NS*	NS*
MW102B	6.0	ND	39.7	18.3	ND	20.4
MW102C	4.2	ND	84.6	ND	ND	39.5
MW103A'	2.6	ND	14.3	ND	ND	ND
MW103B	4.9	ND	4.9	ND	ND	ND
MW103C	12.5	ND	**283**	20.6	ND	94.1
MW104A'	5.6	ND	7.9	ND	5.0	ND
MW104B	16.9	ND	2.8	ND	14.6	ND
MW104C	6.3	ND	2.5	ND	5.6	ND

Table 2-3
RBAAP Maximum/Minimum Chromium and Cyanide Concentrations During 1986-1993 Detected in Groundwater (Continued)

MONITOR WELL	CHROMIUM		CYANIDE		QUARTER 3, 1993	
	MAX ug/L	MIN ug/L	MAX ug/L	MIN ug/L	Cr ug/L	CN ug/L
MW105A'	6.1	ND	4.8	ND	ND	ND
MW105B	**248**	ND	16.3	ND	**146 (139)**	ND (16.3)
MW105C	18.6	ND	18.0	ND	18.6	ND
MW107A'	**140**	7.6	93.3	7.2	**54.2 (55.0)**	76.7 (83.8)
MW107B	**50.0**	6.5	139	87.0	6.5	87.0
MW107C	**110**	**70.0**	93.3	30.1	**86.2**	81.9
MW108A'	5.3	ND	ND	ND	ND	ND
MW108B	**395**	9.3	10.7	ND	**395**	ND
MW108C	**80.6**	ND	10.3	ND	40.7	ND
MW109A'	**58.6**	ND	9.1	ND	ND	ND
MW109B	**56.0**	ND	49.0	13.1	24.6	45.4
MW109C	31.9	5.4	6.0	ND	31.9	ND

Notes:

1. Time period represents quarterly sampling program at RBAAP from 1986 to the present.
2. Detection limits are generally 5.0 ug/L for Cr and 16.0 ug/L for CN.
3. ND = Not detected
4. NS* = Well not sampled (due to dryness)
5. NS** = Well not sampled (inoperable)
6. Bold value indicates Cr or CN value exceeding the MCL of 50 ug/L or 200 ug/L respectively.

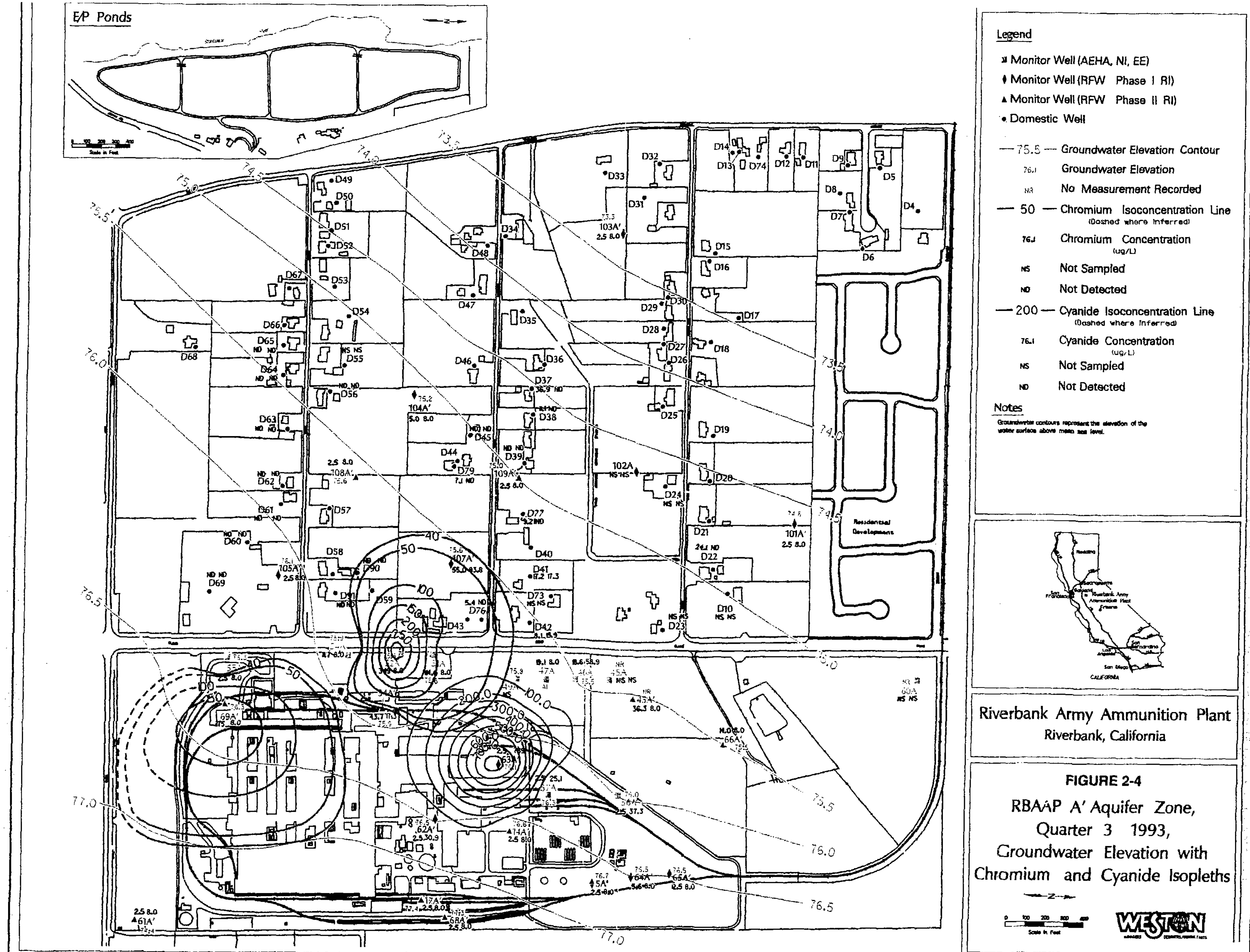
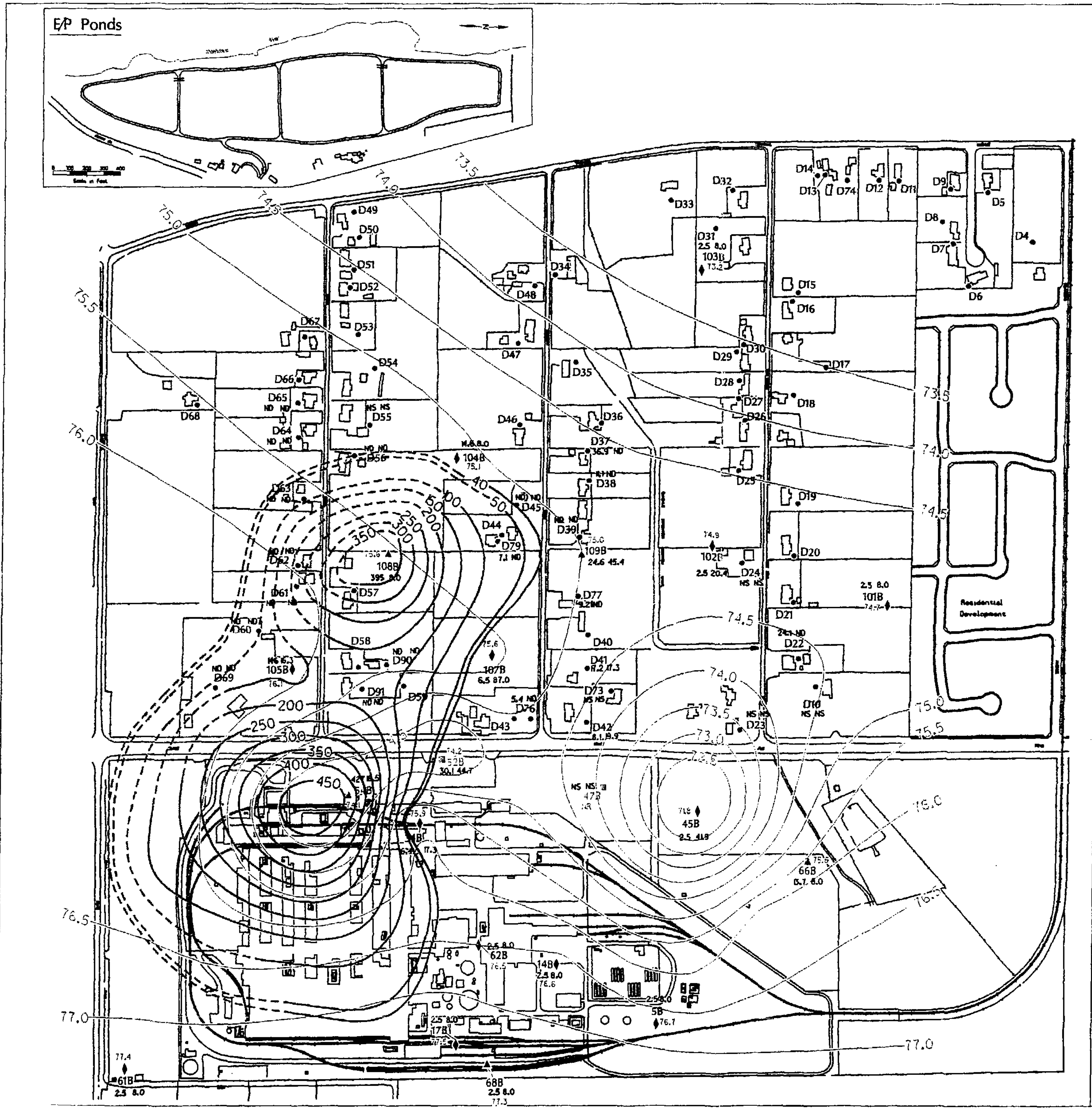


FIGURE 2-4

RBAAP A' Aquifer Zone, Quarter 3 1993, Groundwater Elevation with Chromium and Cyanide Isopleths



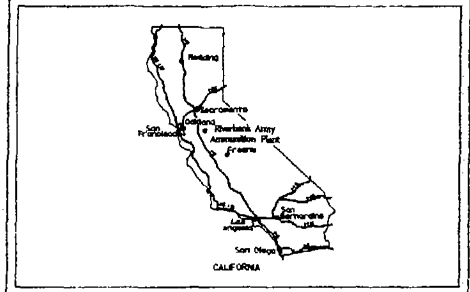
Legend

- Monitor Well (AEHA, NI, EE)
- Monitor Well (RFW Phase I RI)
- Monitor Well (RFW Phase II RI)
- Domestic Well

— 75.5 — Groundwater Elevation Contour
76.1 Groundwater Elevation
NR No Measurement Recorded
— 50 — Chromium Isoconcentration Line (Dashed where Inferred)
76.1 Chromium Concentration (ug/L)
NS Not Sampled
ND Not Detected
— 200 — Cyanide Isoconcentration Line (Dashed where Inferred)
76.1 Cyanide Concentration (ug/L)
NS Not Sampled
ND Not Detected
NR No Measurement Recorded

Notes

Groundwater contours represent the elevation of the water surface above mean sea level.



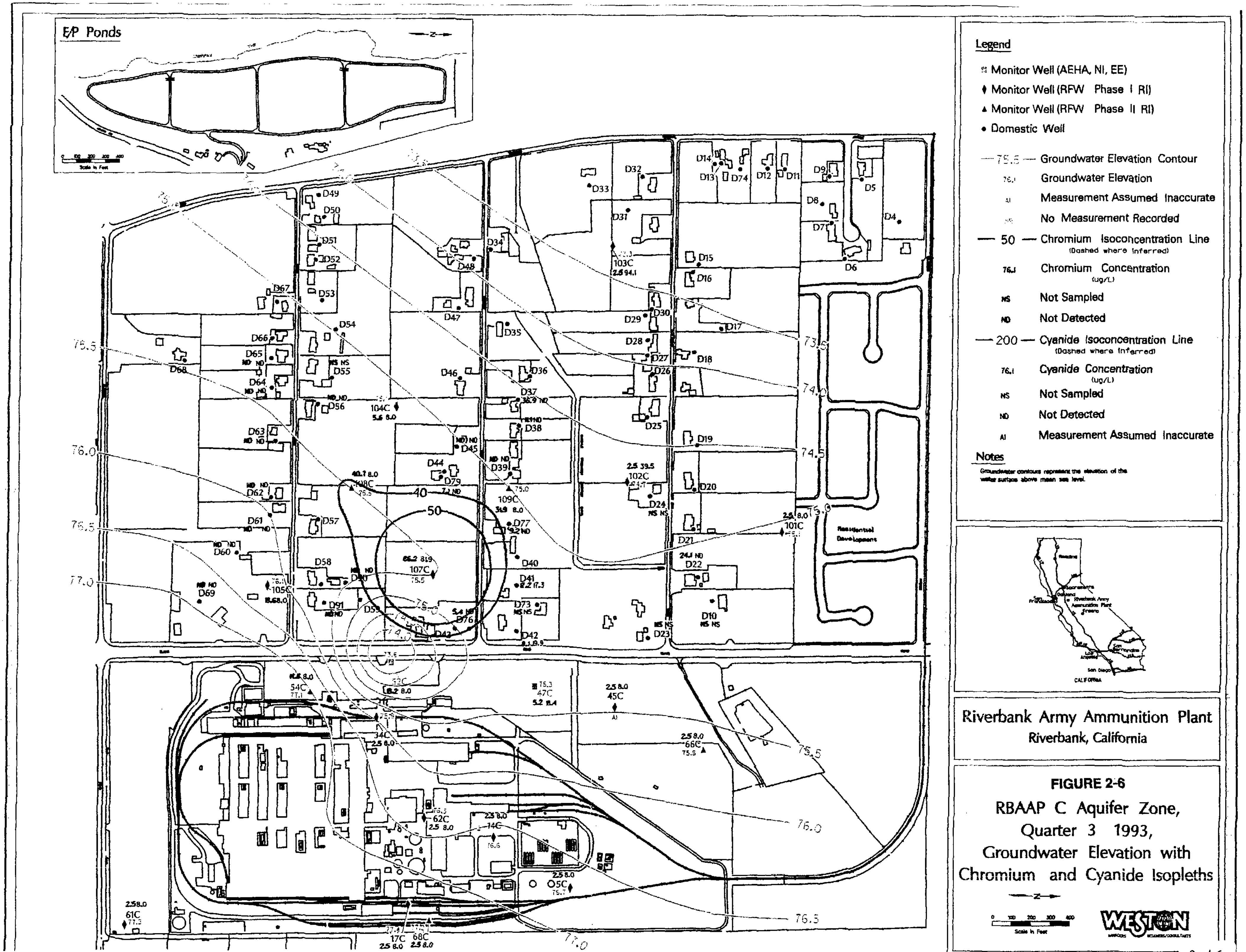
Riverbank Army Ammunition Plant
Riverbank, California

FIGURE 2-5

RBAAP B Aquifer Zone, Quarter 3 1993, Groundwater Elevation with Chromium and Cyanide Isopleths

Scale in Feet

WESTON



Riverbank Army Ammunition Plant
Riverbank, California

FIGURE 2-6
RBAAP C Aquifer Zone,
Quarter 3 1993,
Groundwater Elevation with
Chromium and Cyanide Isopleths

(Title 22, CCR, Section 66261.24). These data are provided in Table 2-4, which indicates that the only contaminants of concern at the site are chromium and cyanide.

In 1985 a quarterly residential well sampling program was initiated to monitor the groundwater quality of the domestic water wells in the residential community located to the west of the site. Six residential wells (D-40, D-43, D-44, D-57, D-58, and D-59) were found to have levels of chromium above the state DWS MCL of 50 $\mu g/L$ for chromium. The contaminated residential wells were replaced with wells that extend into deeper, uncontaminated aquifer zones. Levels of cyanide detected in the residential wells continue to be below the federal and state MCLs of 200 $\mu g/L$.

In December 1992, the residents west of RBAAP were connected to the City of Riverbank public water supply, as described in Subsection 2.3.2. Therefore, the exposure of residents to the groundwater contamination has been greatly reduced.

2.7.2.2 Cyanide Contamination

Four aquifers beneath the site and the off-site study area (A, A′, B, and C aquifer zones) have indicated levels of cyanide greater than the MCL of 200 $\mu g/L$ for cyanide at some point during the RI. Since the A aquifer zone is currently dry in the area of RBAAP, the A′, B, and C aquifer zones are the areas of concern for cyanide contamination in the groundwater. Subsection 2.19.1 discusses plans to address future recharge of the A aquifer zone.

As shown in Table 2-3, historical levels of cyanide have been detected as high as 22,600 $\mu g/L$.

Current cyanide concentrations for monitor wells at RBAAP are also included in Table 2-3. These data indicate that only one on-site monitor well (MW63A′) has a cyanide concentration greater than the MCL of 200 $\mu g/L$. No off-site wells exceed the cyanide

Table 2-4

RBAAP Groundwater Analytical Results for CA Title 22 Metals
Quarter 3 (September), 1993

Well	Antimony (μg/L)	Arsenic (μg/L)	Barium (μg/L)	Beryllium (μg/L)	Cadmium (μg/L)	Cobalt (μg/L)	Total Chromium (μg/L)	Hexavalent Chromium (μg/L)	Copper (μg/L)	Fluoride (μg/L)	Mercury (μg/L)	Molybdenum (μg/L)	Nickel (μg/L)	Lead (μg/L)	Selenium (μg/L)	Silver (μg/L)	Thallium (μg/L)	Vanadium (μg/L)	Zinc (μg/L)
MWP-1	ND(ND)	ND(ND)	ND(ND)	ND(ND)	ND(ND)	ND(ND)	11.1(6.5)	ND(ND)	ND(ND)	ND(ND)	ND(ND)	ND(ND)	ND(ND)	ND(ND)	6.8(ND)	ND(ND)	ND(ND)	ND(ND)	41.0(ND)
MWP-2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	26.0
MWP-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	38.0
MWP-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MWP-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	170	ND	ND	ND	7.5	ND	ND	ND	ND	ND
MW-5A'	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-5B	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-5C	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-14A'	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-14B	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-14C	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-64A'	NS	ND	NS	NS	NS	NS	5.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-65A'	NS	ND	NS	NS	NS	NS	12.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-66A'	NS	ND	NS	NS	NS	NS	14.0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-66B	NS	ND	NS	NS	NS	NS	13.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
MW-66C	NS	ND	NS	NS	NS	NS	ND	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	ND
Detection Limits	60.0	10.0	200	5.0	5.0	50.0	5.0	20.0	25.0	100	0.20	100	40.0	3.0	5.0	10.0	10.0	50.0	20.0

Notes:

NS = Not sampled.
ND = Not detected.
( ) = Duplicate sample.

MCL. An isoconcentration contour map of the cyanide plumes in the A′ aquifer zone is shown in Figure 2-4.

2.7.3 Landfill

As noted in Subsection 2.7.1, the landfill has been identified as a source of groundwater contamination at the site. The areas of landfill contamination are illustrated in Figure 2-7. The source of cyanide contamination at the landfill is the pot liner material, a by-product of aluminum production. The pot liner material is a listed RCRA hazardous waste, with a corresponding listing number K088. The RA did not determine that concentrations of cyanide in the pot liner material (56.4 mg/kg) were a risk to potential residents living on the landfill. However, since the material is a listed hazardous waste, the Army proposed to remove the remaining pot liner fragments to avoid problems associated with any future excavation at the site.

The RA contained in the RBAAP RI Report indicated that levels of arsenic may be hazardous to residents at the landfill. The RA indicated that the combined HI for the residential ingestion and dermal contact exposures was 1.1, primarily due to concentrations of arsenic in the landfill. This HI is slightly above the EPA target HI of 1.0. Due to the conservative nature of the exposure parameters and the low calculation of the combined HI, adverse noncarcinogenic effects are unlikely to occur due to soils at the site.

The screening-level evaluation of risks due to inhalation of chromium-contaminated dusts showed conservatively estimated air concentrations that were slightly greater than the reference concentration (RfC) (3×10^{-6} milligrams per cubic meter (mg/m^3) compared to 2×10^{-6} mg/m^3). The RA stated that due to the extremely conservative and unrealistic nature of the screening-level evaluation, potential dust emissions are not likely to be of concern for any potential real exposures.

The total lifetime cancer risks associated with incidental ingestion and dermal absorption of chemicals in surface soils by hypothetical future on-site residents were 1×10^{-4} and 5 x

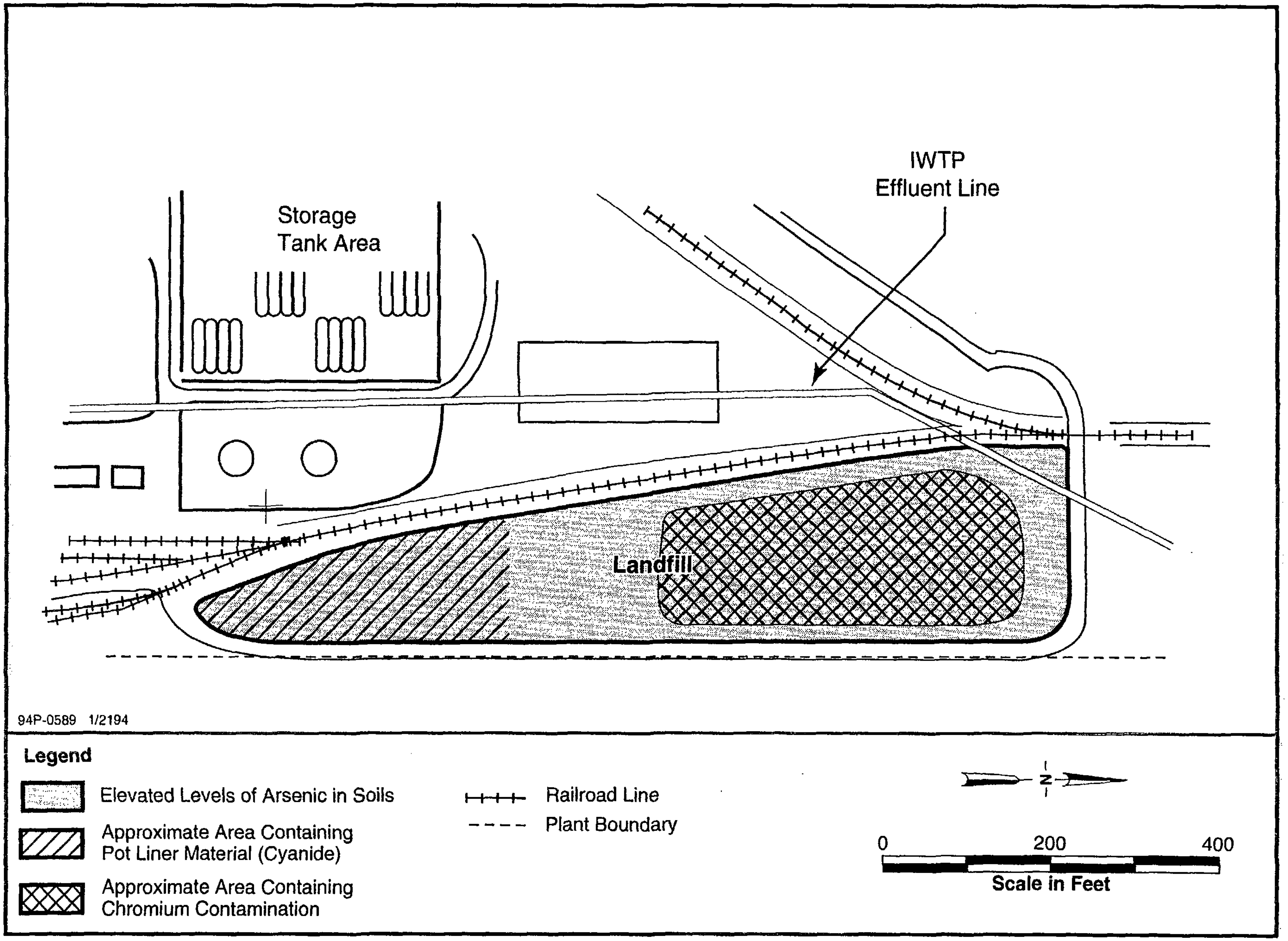


FIGURE 2-7 AREAS OF CONTAMINATION AT THE LANDFILL

10^{-5}, respectively, based on the presence of arsenic in the soil. However, these risks may be overestimated by a factor of 10 due to an uncertainty in the slope factor. EPA is currently reviewing the potential changes to this factor. No cancer risks were identified for the current use scenario at RBAAP, which is also the most probable future use of the site and serves as the basis for conducting remedial actions.

Therefore, no action is warranted at the landfill based on risk to human health. However, in accordance with the Dispute Resolution Agreement, this ROD documents the requirement to place a final cover over the landfill to ensure that residual chromium contamination in the soils does not impact groundwater.

2.8 SUMMARY OF SITE RISKS

A Baseline RA was conducted by WESTON to determine the risks posed to human health and the environment by the contaminants at the site if it remains in its current state with no remediation. The RA is comprised of three main topics, as they apply to the identified contaminants of concern for the site: a toxicity assessment, an exposure assessment, and a health risk evaluation.

Toxicity Assessment — The toxicity assessment documents the adverse effects to a receptor as a result of exposure to a site contaminant. The toxicity assessment considers the relationship between dose and adverse responses, and a chemical's potential to cause other adverse effects such as cancer.

Exposure Assessment — The exposure assessment details the exposure pathways (such as drinking contaminated groundwater) that exist at a site for various receptors such as humans, wildlife, and the environment. In addition, it describes those pathways that may exist in the future.

Health Risk Evaluation — Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one-million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the Hazard Quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the HI can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

A discussion of the overall risks from the affected media at RBAAP is presented in the following subsections.

2.8.1 <u>Groundwater</u>

The risks associated with groundwater at RBAAP were evaluated for the three affected aquifer zones at the site — the A′, B, and C aquifer zones. The A aquifer zone, located between 40 to 50 ft bgs, has become dry because of the existing drought in the Central Valley. To evaluate potential human health risks from the groundwater, several exposure pathways were selected for detailed evaluation under both current and future site use conditions.

2.8.1.1 Exposure Pathways

The exposure pathways evaluated for the no action alternative under **current land use conditions** include:

- Exposure of on-site workers via ingestion of untreated production well groundwater and inhalation while showering.

- Exposure of off-site residents via ingestion of private well groundwater and inhalation while showering.

The exposure pathways evaluated for the no action alternative under **future land use conditions** include:

- Hypothetical exposure of on-site workers via ingestion of untreated on-site groundwater from the A′, B, and C aquifer zones and inhalation while showering.

- Evaluation of on-site groundwater quality, assuming exposure of residents via ingestion of untreated groundwater from the A′, B, and C aquifer zones and inhalation while showering.

- Hypothetical exposure of off-site residents via ingestion of off-site groundwater from the A′, B, and C aquifer zones and inhalation while showering.

2.8.1.2 Quantitative Risk Characterization

The major conclusions of the quantitative risk characterization, outlined in Table 2-5, are summarized below:

- Total lifetime carcinogenic and noncarcinogenic adverse effects associated with ingestion of untreated <u>production well</u> water at the site are unlikely.

- Installation of a waterline extension from the City of Riverbank water system to the residential area adjacent to RBAAP has eliminated resident exposure through ingestion and inhalation, except for incidental ingestion from irrigation and through livestock use.

- In a hypothetical case, noncarcinogenic adverse effects, resulting from ingestion of groundwater from the five contaminated residential wells (now abandoned), might have occurred had these wells remained in service for an extended period.

- Groundwater contamination has exceeded state and federal DWS MCLs for chromium and cyanide at RBAAP. Since the groundwater around RBAAP is a drinking water source, remedial action is necessary to meet MCLs and reduce risks to human health and the environment.

Table 2-5

Major Conclusions of the RBAAP Baseline Risk Assessment for Groundwater

Exposure Pathway	Total Excess Lifetime Carcinogenic Risk		Noncarcinogenic HI		Comments
	Average Case	RME Case	Average Case	RME Case	
Current Land Use Conditions					
On-Site Workers: ingestion of untreated production well water and inhalation of volatilized chemicals while showering.	9E-07	6E-06	5E-02	6E-02	Lower cancer risk associated with methylene chloride, which may be due to laboratory contamination. No adverse noncarcinogenic effects likely to occur from ingestion or other uses. Action risks, if any, from use of treated production well water (data for which are not available) are probably much lower.
Off-Site Residents: ingestion of groundwater from private off-site wells and inhalation of volatilized chemicals while showering.	NR	NR	<0.1	<0.2	More than 70 residential wells sampled for total chromium and total cyanide. No potential for carcinogenic effects to occur from these chemicals from ingestion. All HIs less than or equal to 0.2 for the RME case. No adverse noncarcinogenic effects likely to occur from ingestion. Adverse noncarcinogenic effects are not expected to occur from inhalation of cyanide while showering (high degree of uncertainty, however).
Hypothetical Person: inhalation of chromium-contaminated dusts that have eroded from surface soils in the southern portion of the landfill (screening-level evaluation).	NR	NR	NR	NR	Conservative screening-level results indicate that potential dust emissions are not likely to be of concern for any potential real exposures.
Hypothetical Person: inhalation of cyanide that has volatilized from surface soils at the landfill (screening-level evaluation).	NR	NR	NR	NR	Conservative screening-level results indicate that potential inhalation exposures to any volatile emissions of cyanide are not likely to be of concern for any potential real exposures.

Table 2-5

Major Conclusions of the RBAAP Baseline Risk Assessment for Groundwater (Continued)

Exposure Pathway	Total Excess Lifetime Carcinogenic Risk		Noncarcinogenic HI		Comments
	Average Case	RME Case	Average Case	RME Case	
Hypothetical Future Land Use Conditions					
On-Site Workers: hypothetical ingestion of untreated groundwater and inhalation of volatilized chemicals while showering:					
Aquifer A	4E-07	7E-06	2E-01	9E-01	Low cancer risks, within EPA's target risk range. In addition, there are no detected concentrations above the federal MCL. Noncarcinogenic effects may occur from ingestion and perhaps showering with Aquifer A and B groundwater. Noncarcinogenic risk is associated with exposure to chromium and cyanide (level above federal MCLs). No adverse noncarcinogenic effects likely to occur from ingestion or other uses of Aquifer C groundwater.
Aquifer B	2E-07	5E-06	5E-02	3E-01	
Aquifer C	4E-08	8E-07	2E-02	4E-02	
On-Site Residents: hypothetical ingestion of untreated groundwater and inhalation of volatilized chemicals while showering:					
Aquifer A	9E-07	1E-05	3E-01	3E+00	Low cancer risks, within EPA's target risk range. In addition, there are no detected concentrations above the federal MCL. The HI for the RME case in Aquifer A was above 1. Noncarcinogenic effects may occur from ingestion and perhaps showering with Aquifer A and B groundwater. Noncarcinogenic risk associated with exposure to chromium and cyanide (levels above federal MCLs). No adverse noncarcinogenic effects likely to occur from ingestion or other uses of Aquifer C groundwater.
Aquifer B	3E-07	9E-06	1E-01	8E-01	
Aquifer C	7E-08	1E-06	3E-02	1E-01	
Off-Site Residents: hypothetical ingestion from off-site monitor wells and inhalation of chemicals while showering:					
Aquifer A	NR	NR	5E-02	4E-01	Off-site samples analyzed for 1,1-dichloroethene and inorganics. No potential for carcinogenic effects to occur from these chemicals. Noncarcinogenic effects associated with ingestion may not occur (levels of chromium slightly above federal MCL). Adverse noncarcinogenic effects are not expected to occur from inhalation of cyanide while showering (high degree of uncertainty, however).
Aquifer B	NR	NR	7E-02	3E-01	
Aquifer C	NR	NR	8E-02	5E-01	

Note:

NR = Not relevant.

2.8.1.3 Health Risk Evaluation

The major conclusions of the RA for human risk under hypothetical future land use conditions, which are presented in Table 2-5, are summarized below:

- For on-site workers, adverse noncarcinogenic effects from ingestion of groundwater from the B and C aquifer zones are unlikely. Noncarcinogenic risks associated with exposure to cyanide via inhalation while showering may potentially occur from use of the B aquifer zone groundwater.

  It should be noted that the production wells currently in use at RBAAP do not draw water from the affected aquifer zones.

- For on-site residents, total lifetime cancer risks associated with the use of on-site groundwater are low. However, adverse noncarcinogenic effects may occur related to showering with groundwater from the A and B aquifer zones.

Based on the results of the RA for RBAAP, groundwater remediation is necessary to reduce the risk of chromium and cyanide contamination to human health and the environment.

2.8.2 <u>Soils</u>

2.8.2.1 Landfill

The concentrations of contaminants of potential concern in soils were used in the RA to evaluate the potential impacts of the site on human health and the environment. The exposure pathways evaluated for the soils were inhalation of chromium-contaminated dusts, residents' incidental ingestion of surface soil, and dermal absorption of chemicals in surface soils. These exposure pathways were evaluated in an overall future on-site residential scenario for the site (WESTON, 1991a and 1991b), which would present a worst-case exposure scenario in the calculation of risk potentials.

The screening-level evaluation of risks due to inhalation of chromium-contaminated dusts showed conservatively estimated air concentrations that were slightly greater than the RfC (3×10^{-6} mg/m^3 compared to 2×10^{-6} mg/m^3) for inhalation of chromium. The RA stated that, due to the extremely conservative and unrealistic nature of the screening-level evaluation, potential dust emissions are not likely to be of concern for any potential real exposures.

The RA indicated that the combined HI for the residents' ingestion and dermal contact exposures was 1.1, primarily due to concentrations of arsenic in the landfill. This HI is slightly above the EPA target HI of 1.0. Due to the conservative nature of the exposure parameters and the low calculation of the combined HI, adverse noncarcinogenic effects due to soils at the site are unlikely.

The total lifetime cancer risks associated with incidental ingestion and dermal absorption of chemicals in surface soils by hypothetical future on-site residents were 1×10^{-4} and 5×10^{-5}, respectively, based on the presence of arsenic in the soil. However, these risks may be overestimated by a factor of 10 due to an uncertainty in the slope factor. EPA is currently reviewing the potential changes to this factor. No cancer risks were identified for the current use scenario at RBAAP, which is the most probable future use of the site and serves as the basis for conducting remedial actions.

A summary of the potential risk calculations for incidental ingestion and dermal contact with on-site soils is presented in Tables 2-6 and 2-7, respectively.

According to EPA guidance (EPA, 1989a), "Actions at Superfund sites should be based on the estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land use conditions. The RME is defined here as the highest exposure that is reasonably expected to occur at the site." This position is reiterated in the Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30 (OSWER, 1991). RBAAP is identified by Headquarters (U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) as a critical plant in the Army mobilization plan for the manufacture of military metal parts. Manufacturing lines will be utilized by Army contractors or be properly laid away and maintained for future use. There are no present

Table 2-6

Potential Risks Associated With Incidental Ingestion of On-Site Surface Soil by Residents (0-30 Years Old)[a] Landfill Area

Chemicals Exhibiting Carcinogenic Effects	RME Chronic Daily Intake (CDI) (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Weight-of-Evidence Class[b]	RME Upper-Bound Excess Lifetime Cancer Risk
Arsenic	6.62E-05	1.8E+00	A	1E-04
TOTAL				1E-04
Chemicals Exhibiting Noncarcinogenic Effects	RME CDI (mg/kg-day)	RfD (mg/kg-day) [Uncertainty Factor][c]	Target Organ or Critical Effect[d]	RME CDI:RfD Ratio
Arsenic	2.25E-04	3.0E-04 [3]	Skin	8E-01
Barium	3.48E-04	7.0E-02 [3]	Increased BP	5E-03
Chromium	1.53E-04	1.0E+00 [1,000]	Liver	2E-04
Copper	6.71E-05	3.7E-02 [1]	GI irrit.	2E-03
Total Cyanide	2.33E-04	2.0E-02 [500]	Myelin deg.	1E-02
Fluoride	1.02E-03	6.0E-02 [1]	Dental	2E-02
Mercury	8.87E-07	3.0E-04 [1,000]	Kidney	3E-03
Vanadium	7.62E-05	7.0E-03 [100]	Liver/kidney	1E-02
Zinc	3.84E-03	2.0E-01 [10]	Anemia	2E-02
HAZARD INDEX				<1 (8E-01)

Notes:

[a]Risks are calculated for those chemicals of potential concern with toxicity criteria. The following chemicals of potential concern are not presented due to lack of toxicity criteria: lead.
[b]EPA Weight-of-Evidence for Carcinogenic Effects:
A = Human carcinogen based on adequate evidence from human studies.
[c]Uncertainty factors represent the amount of uncertainty in extrapolation from the available data.
[d]A target organ is the organ most sensitive to a chemical's toxic effect. RfDs are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, the organ listed is one known to be affected by the particular chemical of concern.

Table 2-7

Potential Risks Associated With Dermal Contact With On-Site Surface Soil by Residents (0-30 Years Old)[a] Landfill Area

Chemicals Exhibiting Carcinogenic Effects	RME Chronic Daily Intake (CDI) (mg/kg-day)	Slope Factor $(mg/kg\text{-}day)^{-1}$	Weight-of-Evidence Class[b]	RME Upper-Bound Excess Lifetime Cancer Risk
Arsenic	2.78E-05	1.8E+00	A	5E-05
TOTAL				5E-05
Chemicals Exhibiting Noncarcinogenic Effects	**RME CDI (mg/kg-day)**	**RfD (mg/kg-day) [Uncertainty Factor][c]**	**Target Organ[d]**	**RME CDI:RfD Ratio**
Inorganics:				
Arsenic	9.48E-05	3.0E-04 [3]	Skin	3E-01
Barium	1.46E-04	7.0E-02 [3]	Inc. BP	2E-03
Chromium	6.45E-05	1.0E+00 [1,000]	Liver	6E-05
Copper	2.82E-05	3.7E-02 [1]	GI irrit.	8E-04
Cyanide	9.78E-05	2.0E-02 [500]	Myelin deg.	5E-03
Fluoride	4.27E-04	6.0E-02 [1]	Dental	7E-03
Mercury	3.73E-07	3.0E-04 [1,000]	Kidney	1E-03
Vanadium	3.21E-05	7.0E-03 [100]	Liver/kidney	5E-03
Zinc	1.61E-03	2.0E-01 [10]	Anemia	8E-03
HAZARD INDEX				<1 (3E-01)

Notes:

[a]Risks are calculated for those chemicals of potential concern with toxicity criteria. The following chemicals of potential concern are not presented due to lack of toxicity criteria: lead.
[b]EPA Weight-of-Evidence for Carcinogenic Effects:
A = Human carcinogen based on adequate evidence from human studies.
[c]Uncertainty factors represent the amount of uncertainty in extrapolation from the available data.
[d]A target organ is the organ most sensitive to a chemical's toxic effect. RfDs are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, the organ listed is one known to be affected by the particular chemical of concern.

or future Army plans for closing the plant, and it is scheduled to remain under Army control indefinitely for mobilization purposes.

Based on the above plans, the most probable future use of RBAAP is continued use as a military industrial complex. Cleanup is not required based on risk, since the current use scenario (also the most probable future use of the site) did not identify risks due to soils at RBAAP. To ensure that appropriate measures are taken to re-address arsenic risks in the event of future Army decisions to close RBAAP or portions thereof, deed restrictions will be placed on the landfill preventing transfer to residential use.

2.8.2.2 E/P Ponds

EPA Region IX conducted a Phase I Environmental Assessment of the E/P ponds on 19 March and 9 April 1992. The assessment was performed to identify potential critical habitats, thereby ensuring that the remedy selected for remediation of the ponds would be protective of human health and the environment.

The field surveys performed during the assessment indicated that the E/P ponds area has a diverse riparian habitat and is one of the last places in the Riverbank area that serves as a suitable habitat for a wide variety of aerial and terrestrial species. EPA recommended that the Army, as a natural resource trustee for the site, continue to preserve the E/P ponds area from further development in order to preserve the flora and fauna remaining in the area.

The Phase I assessment also determined that the ponds do not pose a threat to human health based on available data. However, the elevated levels of zinc, which have since been removed, posed a "very low" potential environmental risk to the ecological receptors (flora and fauna) in the area.

2.8.3 Ecological Risk Assessment

Absolute conclusions regarding the potential environmental impacts of the chemicals of concern at RBAAP cannot be made because there are a number of uncertainties associated with the estimates of toxicity and exposure, and these should be noted when reviewing the conclusions for the RBAAP study areas. However, given the available data and limitations, the general conclusions regarding the potential for environmental impacts are summarized below. These conclusions are based on the comparison of soil concentrations to Toxicity Reference Values (TRVs), as shown in Tables 2-8 and 2-9.

RBAAP Landfill: Chromium concentrations (and perhaps other chemicals of concern (e.g., copper and fluoride)) in the northern portion of the landfill may result in adverse effects to some species of plants and earthworms. Toxicity values were not available for cyanide and samples were not analyzed for other potential chemicals of concern; therefore, potential risks to plants and earthworms could not be fully evaluated.

IWTP Effluent Pipe Leak: Concentrations of chromium, copper, and fluoride in soils at the IWTP effluent leak area may be phytotoxic to most species of plants. Concentrations of chromium also may be toxic to earthworms.

Industrial Waste Pipe Leak: Concentrations of thallium and zinc in soils in the Industrial Waste Pipe Leak area could be toxic to some plant species. Earthworms are not expected to be adversely affected by the soil concentrations of arsenic, chromium, lead, and zinc. Earthworm TRVs are not available for molybdenum, silver, and thallium; therefore, potential risks could not be evaluated for these chemicals.

E/P Ponds: EPA Region IX conducted a Phase I Environmental Assessment for the E/P ponds on 19 March and 9 April 1992. The assessment was performed to identify the potential critical habitats, thereby ensuring that the remedy selected for the zinc removal action would be protective of human health and the environment.

Table 2-8

Comparison of Soil Concentrations to Toxicity Reference Values (TRVs) for Terrestrial Plants*

Chemical	Average Case			RME Case	
	TRV (mg/kg)	Soil Concentration (mg/kg)	Ratio of Soil Concentration to TRV	Soil Concentration (mg/kg)	Ratio of Soil Concentration to TRV
<u>Landfill</u>					
Chromium (total)	94	28	0.30	38.5	0.41
Cyanide (total)	NA	40	---	200	---
<u>IWTP Effluent Leak Area</u>					
Chromium (total)	94	32	0.34	120	1.3
Copper	98	167	1.7	803	8.2
Fluoride	567	1,297	2.3	2,900	5.1
<u>IWP Leak Area</u>					
Arsenic	28	2.3	0.080	2.5	0.089
Chromium (total)	94	12.7	0.14	14.1	0.15
Lead	180	6.7	0.037	6.8	0.038
Molybdenum	6	3.9	0.65	4.1	0.68
Silver	2	0.9	0.46	1.0	0.50
Thallium	1	5.1	5.1	5.2	5.2
Zinc	270	876	3.2	893	3.3

Notes:

*All concentrations are mg/kg dry weight.
NA = Not available.
--- = Not relevant.

Table 2-9

Comparison of Soil Concentrations to Toxicity Reference Values (TRVs) for Earthworms*

Chemical	Average Case			RME Case	
	TRV (mg/kg)	Soil Concentration (mg/kg)	Ratio of Soil Concentration to TRV	Soil Concentration (mg/kg)	Ratio of Soil Concentration to TRV
Landfill					
Chromium (total)	71	28	0.39	38.5	0.54
Cyanide (total)	NA	40	---	200	---
IWTP Effluent Leak Area					
Chromium (total)	71	32	0.45	120	1.7
Copper	1,000	167	0.17	803	0.80
Fluoride	NA	1,297	---	2,900	---
IWP Leak Area					
Arsenic	33	2.3	0.070	2.5	0.076
Chromium (total)	71	12.7	0.18	14.1	0.20
Lead	1,314	6.7	0.0051	6.8	0.0052
Molybdenum	NA	3.9	---	4.1	---
Silver	NA	0.9	---	1	---
Thallium	NA	5.1	---	5.2	---
Zinc	992	876	0.88	893	0.90

Notes:

*All concentrations are mg/kg dry weight.
NA = Not available.
--- = Not relevant.

The assessment determined that the ponds do not pose a threat to human health based on available data; however, the elevated levels of zinc pose a "very low" potential environmental risk to the ecological receptors (flora and fauna) in the area.

The assessment recommended that a focused "hot spot" removal of the areas of elevated zinc concentrations be performed to significantly reduce current and/or future risk to the receptors. The removal action conducted at the E/P ponds addressed this recommendation as well as the hazardous waste limit for zinc under California Title 22.

2.8.4 Uncertainties in the Baseline Risk Assessment

A summary of the uncertainties in the RBAAP Baseline Risk Assessment is presented in Table 2-10. The uncertainties associated with the Ecological Risk Assessment should be noted when reviewing the results. The main sources of uncertainty are related to toxicity assessment and exposure assessment. The toxicity of the chemicals to plants and earthworms depends in part on the species of receptor and the availability and form of the chemical. The TRVs used in this assessment are derived from toxicity information available in the literature, and they are used in the absence of more detailed site-specific information. No plant or earthworm TRVs are available for cyanide, thus the potential risks from this chemical could not be evaluated. In addition, toxicity information was not available for earthworms for molybdenum, silver, and thallium; therefore, potential risks from these chemicals could not be evaluated.

2.9 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

The development of remedial action objectives for RBAAP is aimed at protecting human health and the environment through media-specific or operable unit (OU)-specific goals. The RI for RBAAP identified contaminants of concern, pathways of migration, and associated exposure. The contaminants of concern in the groundwater are chromium and cyanide. The pathways of exposure include ingestion and inhalation (during showering). The groundwater remediation goals have been agreed upon by the regulatory agencies and

Table 2-10

Summary of Uncertainties in the RBAAP Baseline Risk Assessment

Assumption	Magnitude of Effect on Risk*	Direction of Effect on Risk
Environmental Sampling and Analysis		
Potentially naturally occurring levels of inorganics that may not be associated with operations attributed to the site.	Low	May overestimate risk.
Systematic or random errors in the chemical analyses may yield erroneous data.	Low	May over- or underestimate risk.
Chemical concentrations reported as "below the method quantitation limit" (e.g., labeled "U") are included as one-half the quantitation limit.	Low	May over- or underestimate risk.
Exposure Parameter Estimation		
The standard assumption regarding body weight, period exposed, life expectancy, population characteristics, and lifestyle may not be representative of any actual exposure situation.	Moderate	Would tend to overestimate risk given the conservative assumptions used.
The amount of media intake is assumed to be constant and representative of the exposed population.	Low	Would tend to overestimate risk given the conservative assumptions used.
Concentration of contaminant remain constant over exposure period.	Low	Would tend to overestimate risk for most exposure points.
Combining upper bound estimates of exposure parameters using a simple intake equation to estimate exposure to represent the RME.	Moderate	Would tend to overestimate exposure and risk.
Toxicological Data		
The cancer slope factors used are upper bound estimates.	High	May overestimate risk. However, potential noncarcinogenic effects are the main focus of the report.
Risks are assumed to be additive. Risks may not be additive because of synergistic or antagonistic actions of other chemicals.	Low	May over- or underestimate risk.
Dose-response data were not available for all of the selected chemicals of potential concern.	Moderate	May underestimate risk.
Due to uncertainty associated with its carcinogenicity, 1,1-dichloroethane, a Class C carcinogen, was evaluated as a noncarcinogen by incorporating an additional safety factor of 10.	Low	Will have little impact on risk since evidence of carcinogenicity is weak, and noncarcinogenic risk was evaluated more conservatively.

Note:
*As a general guideline, assumptions marks as "low" may affect estimates of exposure by less than an order of magnitude; assumptions marked "moderate" may affect estimates of exposure by between one and two orders of magnitude; and assumptions marked "high" may affect estimates of exposure by more than two orders of magnitude.

Source: RBAAP RI Report, July 1991.

the Army. These groundwater remediation goals are the federal and/or state DWS MCLs for chromium and cyanide of 50 μg/L and 200 μg/L, respectively.

A study was conducted (pursuant to Title 23, CCR Division 3, Chapter 15, Section 2550.4) to demonstrate the potential feasibility of remediating the groundwater to background concentrations, in addition to remediating the groundwater to the goals mentioned above. This study was performed to determine whether a more stringent groundwater cleanup is technologically and economically feasible. The study used the groundwater extraction scenario (Case D) at a total extraction rate of 120 gpm to provide a common basis for comparison. The difference between the two systems would then be the time required to achieve background versus MCLs within the same plume capture area. The extent of the chromium and cyanide plumes following extraction under Case D conditions was simulated using the contaminant transport model to determine whether background concentrations (5 μg/L for chromium and below the detection limit of 10 μg/L for cyanide) in groundwater could be achieved in a reasonable time frame.

Figures 2-8 and 2-9 illustrate the results of the model simulations for chromium and cyanide, respectively. The simulations indicated that an ambient chromium concentration of 5 μg/L would be achieved in 100 years, with maximum concentrations of 7 μg/L in the three aquifer zones. However, maximum cyanide concentrations between 19 and 22 μg/L were indicated during the 100-year model simulation, which is above the background concentration, and indicates that pumping exceeding 100 years would be required. Graphical representations of chromium and cyanide concentrations over time for specific well locations are provided in Appendix C.

Figures 2-10 and 2-11 illustrate the model predictions for the time required to attain MCLs in groundwater with the same extraction scenario (Case D). As depicted in the figures, the model predicts chromium and cyanide will reach MCLs within 5 years.

In addition to the additional years of operation, the extraction and treatment system would have to be expanded to fully capture and treat the chromium and cyanide plumes to

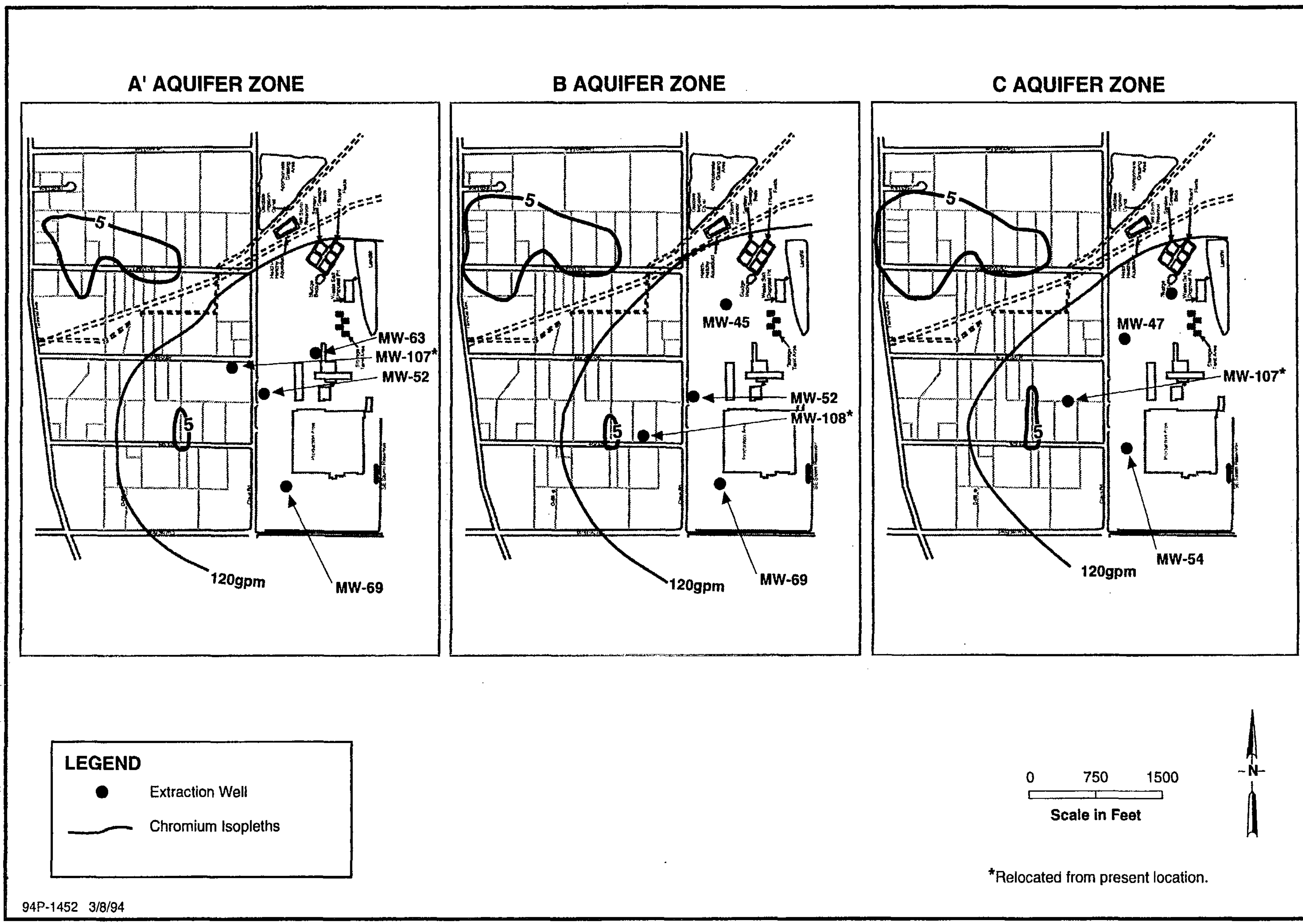


FIGURE 2-8 CHROMIUM ISOPLETHS -100 YEAR SIMULATION TO AMBIENT LEVELS
BASED ON CASE D SCENARIO

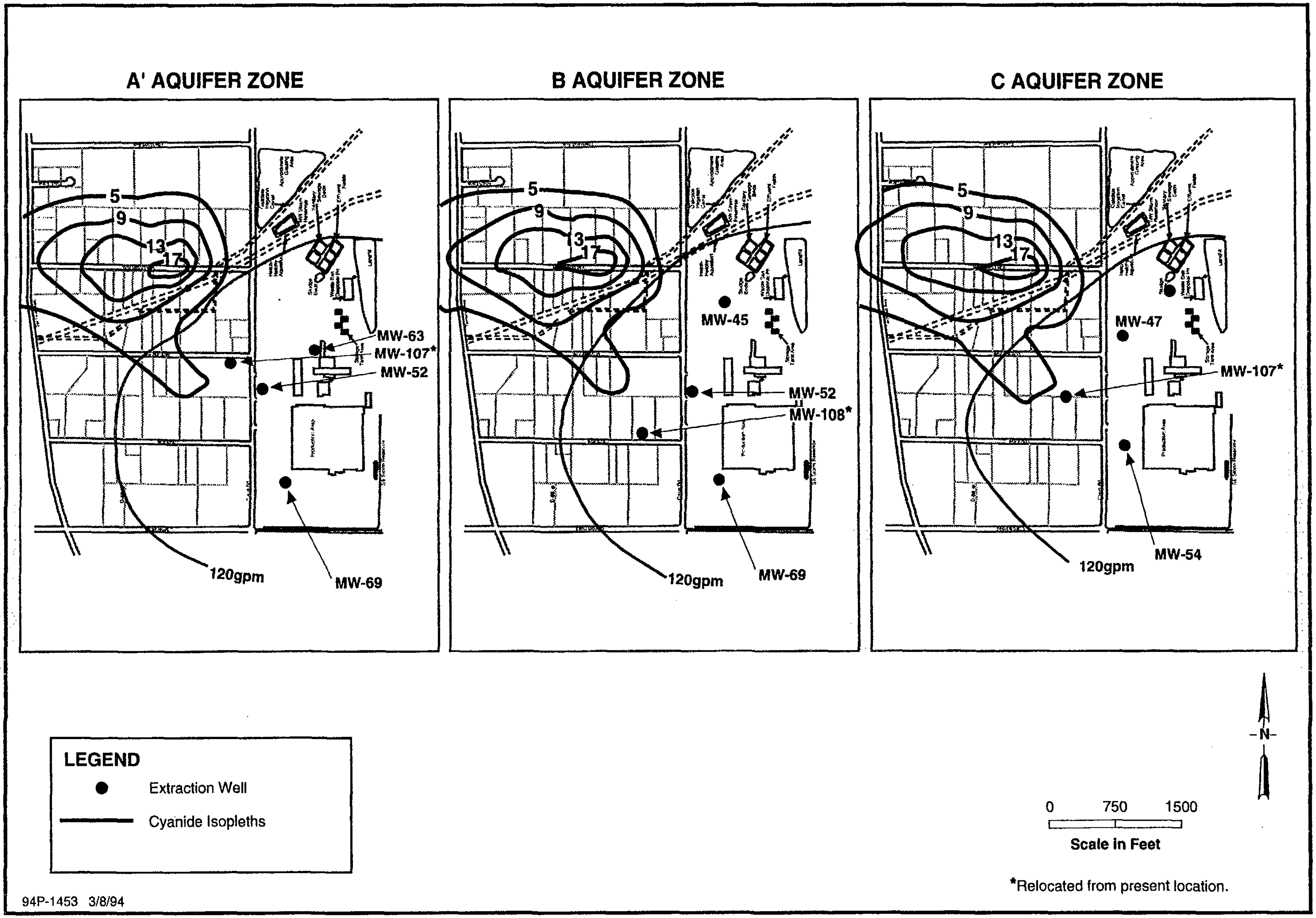


FIGURE 2-9 CYANIDE ISOPLETHS - 100 YEAR SIMULATION TO AMBIENT LEVELS BASED ON CASE D SCENARIO

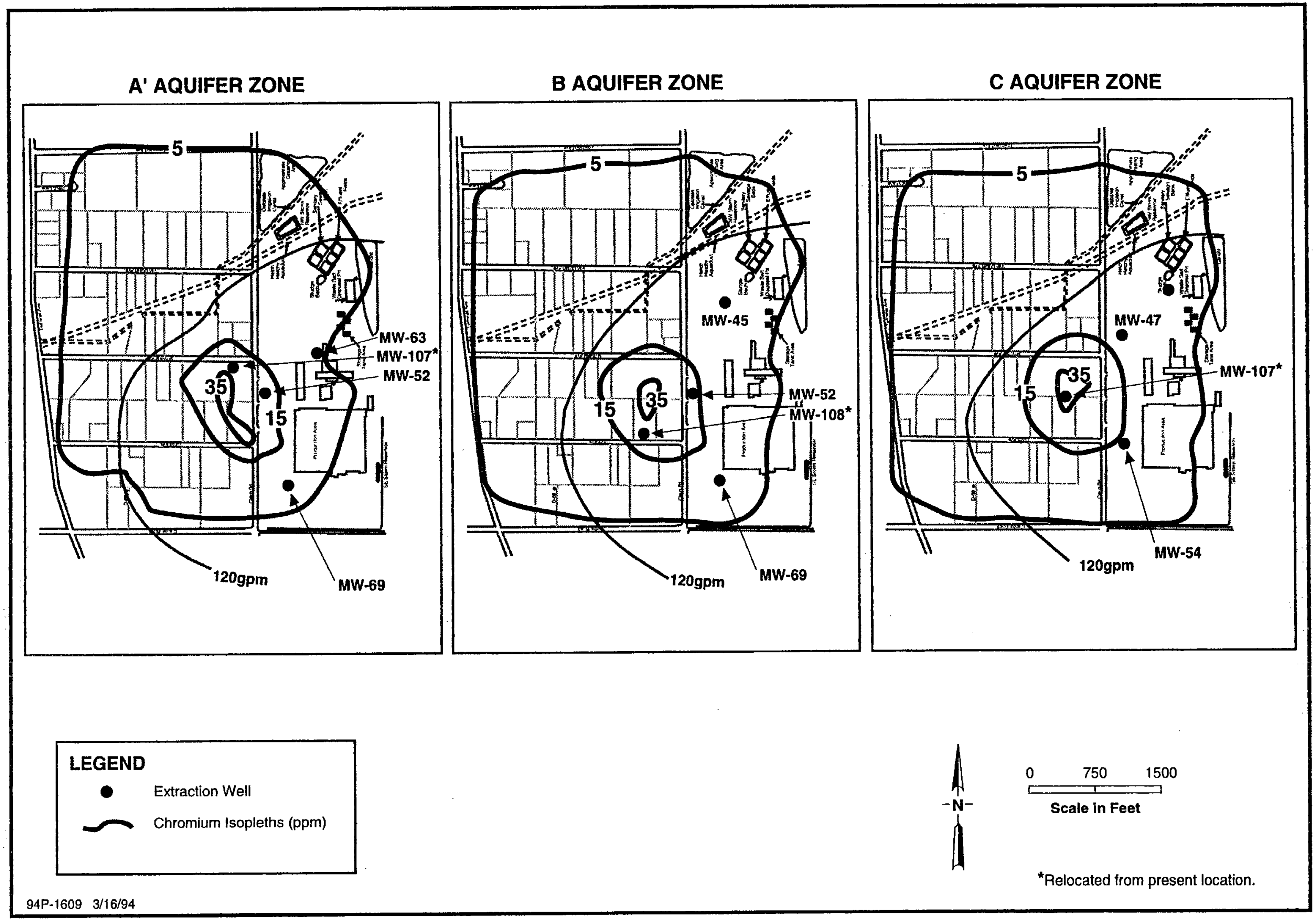


FIGURE 2-10 CHROMIUM ISOPLETHS - 5 YEAR SIMULATION TO MCLs BASED ON CASE D SCENARIO

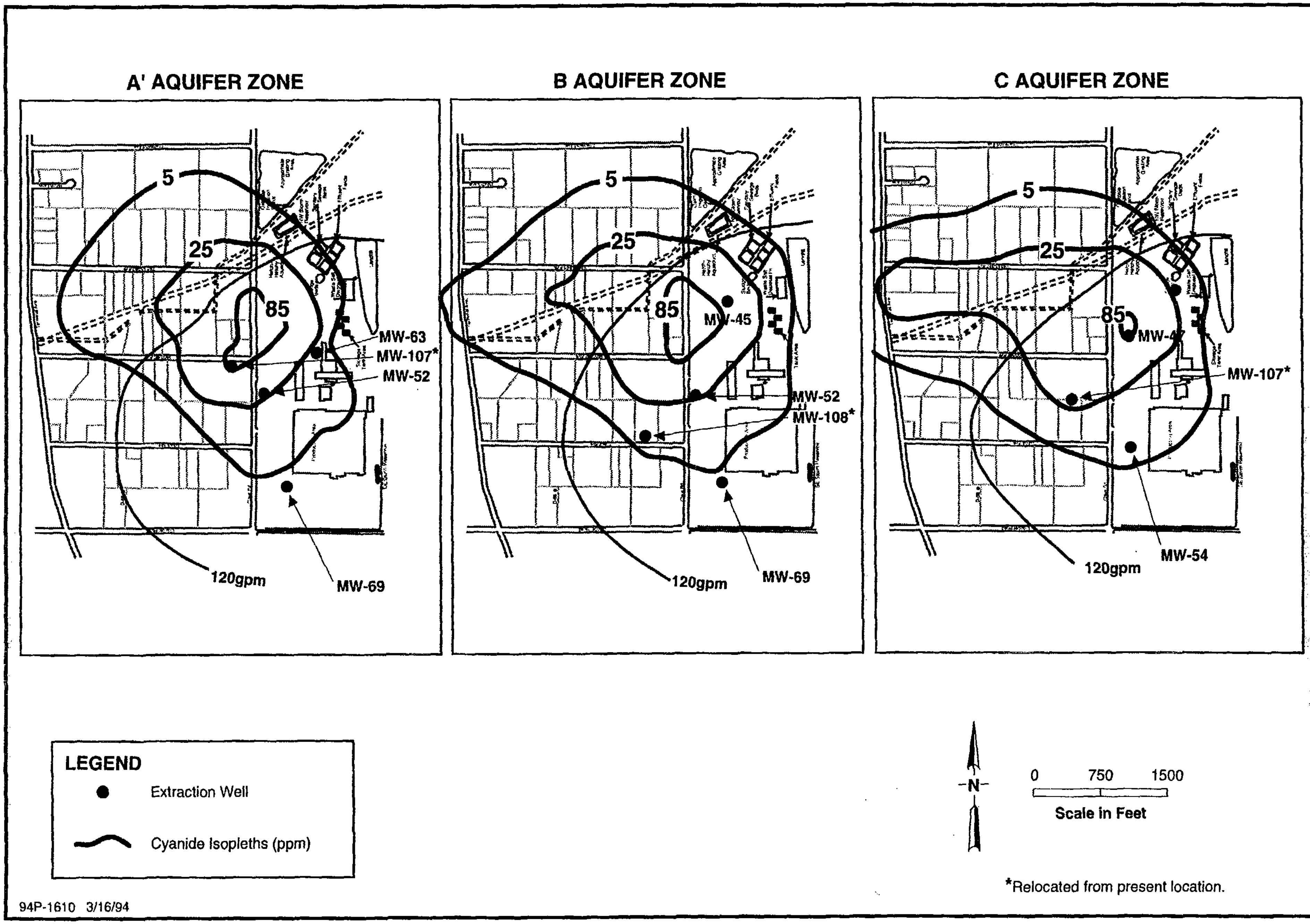


FIGURE 2-11 CYANIDE ISOPLETHS - 5 YEAR SIMULATION TO MCLs BASED ON CASE D SCENARIO

background. Therefore, based on the extended duration required to remediate the groundwater to background levels and the need to expand the extraction and treatment system required to fully capture to background, it is not considered economically feasible to meet this more stringent cleanup requirement.

The total cancer risk potentials associated with incidental ingestion and dermal absorption of chemicals in soils at RBAAP by hypothetical on-site residents were 1×10^{-4} and 5×10^{-5}, respectively, based on the presence of arsenic in soils at the landfill. However, EPA guidance (EPA, 1989a) states that "actions at Superfund sites should be based on the estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land use conditions. The RME is defined here as the highest exposure that is reasonably expected to occur at the site." This position is reiterated in OSWER Directive 9355.0-30 (OSWER, 1991). RBAAP is identified by AMCCOM as a critical plant in the Army mobilization plan for the manufacture of military metal parts. Manufacturing lines will be utilized by Army contractors or be properly laid away and maintained for future use. There are no present or future Army plans for excessing the plant. The plant is scheduled to remain indefinitely under Army control for mobilization purposes.

Based on the above plans, the most probable future use of RBAAP is continued use as a military industrial complex. In light of these factors, cleanup is not required based on risk, since the current use scenario (which is the most probable future use of the site) did not identify risks due to soils at RBAAP. To ensure that appropriate measures are taken to re-address arsenic risks in the event of future Army decisions to access RBAAP or portions thereof, access and deed restrictions will be placed on the landfill preventing transfer to residential use.

Although risks were not identified due to concentrations of cyanide in the soils, the pot liner material is listed as a hazardous waste under RCRA. The pot liner material is listed based on cyanide concentrations in the material, and has a corresponding EPA hazardous waste number K088. Upon excavation, the material would require treatment prior to redisposal on land.

Based on the above criteria, the following remedial action objectives have been selected:

- **Remediation of Groundwater** — Alternatives will be developed that will restore the groundwater in all water-bearing zones to remediation goals.

- **Remediation at the Landfill** — Alternatives will be developed to remediate the landfill to protect human health and the environment, including water quality.

2.10 DESCRIPTION OF TREATED GROUNDWATER DISPOSAL ALTERNATIVES

An analysis of treated groundwater disposal alternatives was necessary since the selection of a disposal option will determine the goals for the final groundwater treatment system. The following three alternatives were analyzed and evaluated in the FS (WESTON, 1993):

- Alternative 1: Discharge to the OID Canal — This alternative involves the discharge of treated effluent via new pipeline to a branch of the OID Canal, which traverses the northwest corner of the RBAAP facility.

- Alternative 2: Discharge to the E/P Ponds — This alternative involves discharge to the E/P ponds through the existing IWTP effluent pipeline at the site.

- Alternative 3: Injection Into the A′ Aquifer Zone — This alternative involves the installation of eight injection wells to be installed along the eastern boundary of RBAAP. Additional treatment of the groundwater may be required to make the injected groundwater meet the existing water quality of the A′ aquifer zone.

2.11 SUMMARY OF COMPARATIVE ANALYSIS OF TREATED GROUNDWATER DISPOSAL ALTERNATIVES

2.11.1 Threshold Criteria

2.11.1.1 Overall Protection of Human Health and the Environment

The overall protection of human health and the environment will mainly be determined by the final groundwater extraction and treatment system. If the treatment meets the individual requirements for discharge in each alternative, overall protection is ensured.

2.11.1.2 Compliance With ARARs

Alternatives 1 and 2 must meet the same ARARs for disposal. Alternatives 1 and 2 must meet federal ambient water quality criteria (AWQC) and state Water Quality Objectives (WQOs), which will be incorporated into an NPDES permit issued by CA EPA-RWQCB. The effluent from the IWTP at RBAAP and the treated effluent from the IGWTS are commingled. The IWTP effluent is regulated by existing WDRs issued by RWQCB. The discharge of commingled treated groundwater will be governed by the same WDRs that will be revised to include a NPDES permit. The IGWTS effluent must therefore comply with all conditions and requirements contained therein. Pursuant to Section 17.3 of the Federal Facilities Agreement (FFA) for RBAAP, the effluent requirements as set forth in Table 2-1 for chromium and cyanide will be included in the revised WDRs covering the discharge of the effluent.

Alternative 3 is governed by the California nondegradation policy and the underground injection control (UIC) requirements. The nondegradation policy requires that the treated groundwater must not degrade the existing water quality in the receiving water. In this case, the nondegradation policy is a more stringent ARAR than the applicable AWQC or WQOs. Therefore, Alternative 3 would require that the final groundwater treatment system provide more extensive treatment than would be required for Alternatives 1 and 2.

The ARARs and the effluent limitations for chromium and cyanide relating to these alternatives are presented in Table 2-1.

2.11.2 Primary Balancing Criteria

2.11.2.1 Long-Term Effectiveness and Permanence

No residual risks are expected from these alternatives. Flow patterns are expected to return to previous conditions for each of these alternatives.

2.11.2.2 Reduction of Toxicity, Mobility, and Volume of Contaminants

This evaluation criterion is inappropriate for evaluating the treated groundwater disposal options since the groundwater will be extracted and treated prior to disposal.

2.11.2.3 Short-Term Effectiveness

In meeting ARARs, each alternative will pose no threat to human health or the environment. Alternative 1 will provide a potential beneficial use of the treated groundwater for irrigation, whereas Alternatives 2 and 3 will provide recharge of groundwater.

Design of the injection system for Alternative 3 will have to be performed in conjunction with the final groundwater extraction system since the extraction rates and the locations of extraction wells will determine the number and placement of injection wells.

2.11.2.4 Implementability

Alternatives 1 and 2 are readily implemented. Alternative 1 requires the installation of an underground pipeline from the final groundwater treatment system to the OID Canal. Alternative 2 may require an underground pipeline, depending on the selection of the final groundwater treatment system. Both alternatives require discharge permits for disposal.

Alternative 3 involves the installation of an injection well system, including wells, piping, and pumps. This alternative requires additional construction and maintenance compared to Alternatives 1 and 2. For Alternative 3, the final groundwater treatment system will be required to meet the background water quality in the A′ aquifer zone, as opposed to the treatment system necessary for Alternatives 1 and 2.

UIC permits will be required for Alternative 3.

2.11.2.5 Cost

The present worth cost for each alternative is as follows:

- Alternative 1: $88,700.
- Alternative 2: $84,700.
- Alternative 3: $203,000.

2.11.3 <u>Modifying Criteria</u>

2.11.3.1 EPA/CA EPA Acceptance

EPA and CA EPA (comprised of both the DTSC and the RWQCB), along with the Army, have concurred with the selection of using either Alternative 1 (Discharge to the OID Canal) or Alternative 2 (Discharge to the E/P Ponds) for the disposal of treated groundwater. In addition, the parties have agreed that, although both alternatives are acceptable, Alternative 1 is preferred due to potential beneficial use of the treated effluent.

2.11.3.2 Community Acceptance

Public comments on the selected remedial actions were presented at the public meeting on 31 August 1993. No other comments were received during the public comment period. No comments from the public were raised relating to the discharge of treated groundwater.

2.12 <u>DESCRIPTION OF GROUNDWATER EXTRACTION AND TREATMENT ALTERNATIVES</u>

2.12.1 <u>Alternative 1: No Action With Groundwater Monitoring</u>

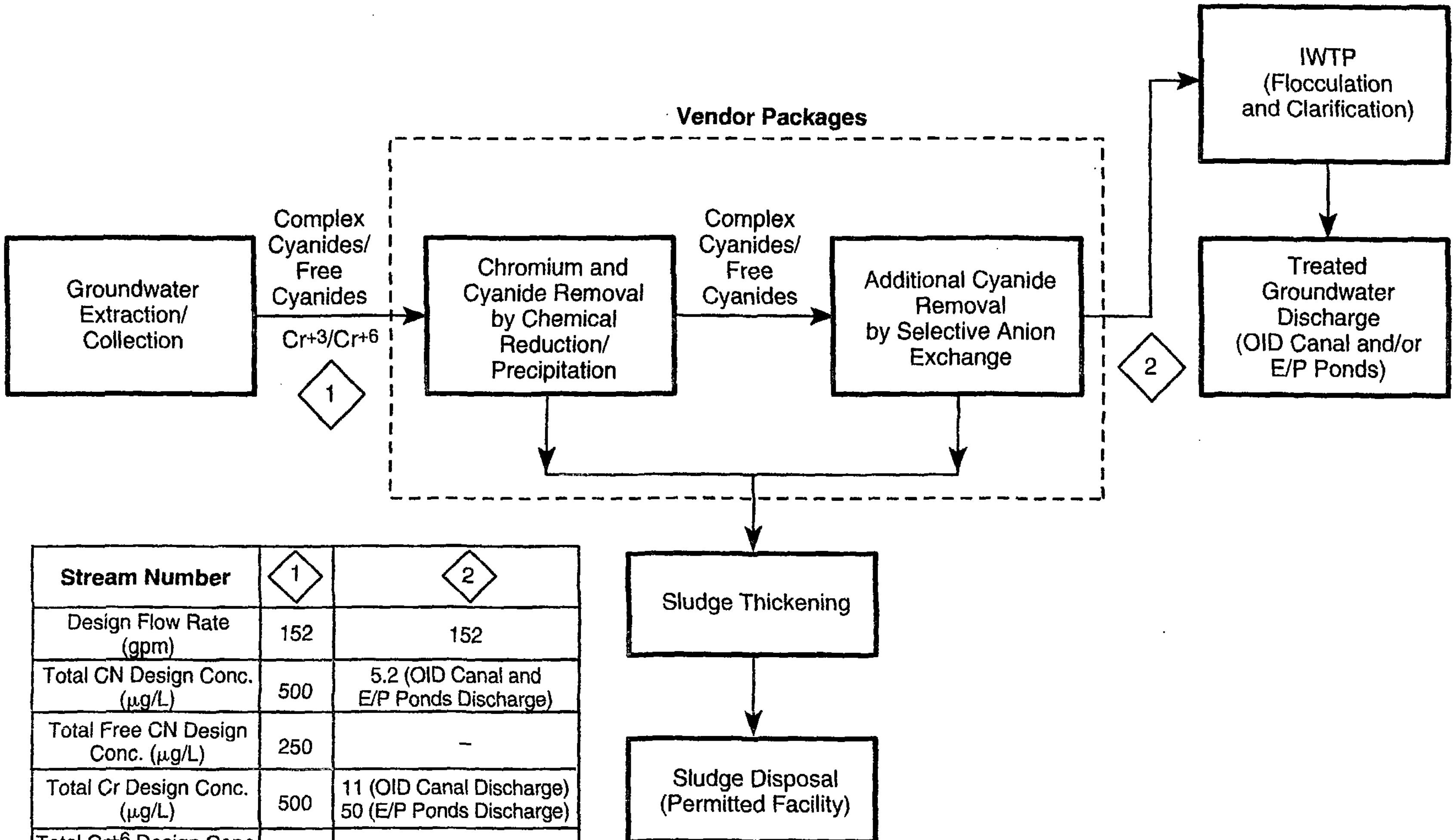
Alternative 1: No Action With Groundwater Monitoring, provides a basis for comparing existing site conditions with those resulting from implementation of the other proposed alternatives. Under Alternative 1, reduction in the concentrations of the key contaminants in groundwater is achieved via natural attenuation. The major component of this alternative is the implementation of a long-term, quarterly groundwater monitoring program of all existing A′, B, and C aquifer zone monitor wells. All on-site and off-site monitor wells plus an estimated 15 residential wells will be sampled to adequately monitor the progression of chromium and cyanide plumes. Sampling at these locations would provide information on groundwater flow and quality.

For Alternative 1, existing groundwater contaminant migration pathways remain in place as no remedial activities are implemented at the site. The contaminants of concern in groundwater (A′, B, and C aquifer zones) are chromium and cyanide. These chemicals exceed the remedial action objectives (state MCLs) in certain monitor wells on-site. The monitoring of existing wells will serve as an early warning to any potential remaining users of the groundwater downgradient of the site. Monitoring will continue until such time as the concentrations of the cyanide and chromium in the monitor wells and residential wells indicate acceptable levels established for groundwater at the site (i.e., remedial action objectives). The monitoring program itself will not actively improve groundwater conditions.

2.12.2 Alternative 2: Continued Extraction and Treatment Utilizing the IGWTS and IWTP

Alternative 2 involves the use of the existing extraction and treatment system operating at the site as the final groundwater extraction and treatment system while conducting a long-term groundwater monitoring program as described in Alternative 1. The system has been in operation since October 1991.

The process flow schematic for the extraction and treatment system is shown in Figure 2-12. The current system extracts groundwater at a rate of 76 gpm from eight wells located along the western boundary of the site. Four wells (MW-45B, MW-47B, MW-52B, and MW-54B) extract groundwater from the B aquifer zone at a rate of 16 gpm each. The remaining four wells (MW-45C, MW-47C, MW-52C, and MW-54C) extract groundwater from the C aquifer zone at a rate of 3 gpm each. The current system does not extract groundwater from the A′ aquifer zone. The extracted groundwater is pumped through a 3-inch polyvinyl chloride (PVC) line to the treatment system. The extraction schematic is shown in Figure 2-13.



Stream Number	1	2
Design Flow Rate (gpm)	152	152
Total CN Design Conc. (μg/L)	500	5.2 (OID Canal and E/P Ponds Discharge)
Total Free CN Design Conc. (μg/L)	250	–
Total Cr Design Conc. (μg/L)	500	11 (OID Canal Discharge) 50 (E/P Ponds Discharge)
Total Cr^{+6} Design Conc. (μg/L)	250	–

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FIGURE 2-12 ALTERNATIVES 2 AND 3 - IGWTS PROCESS FLOW SCHEMATIC

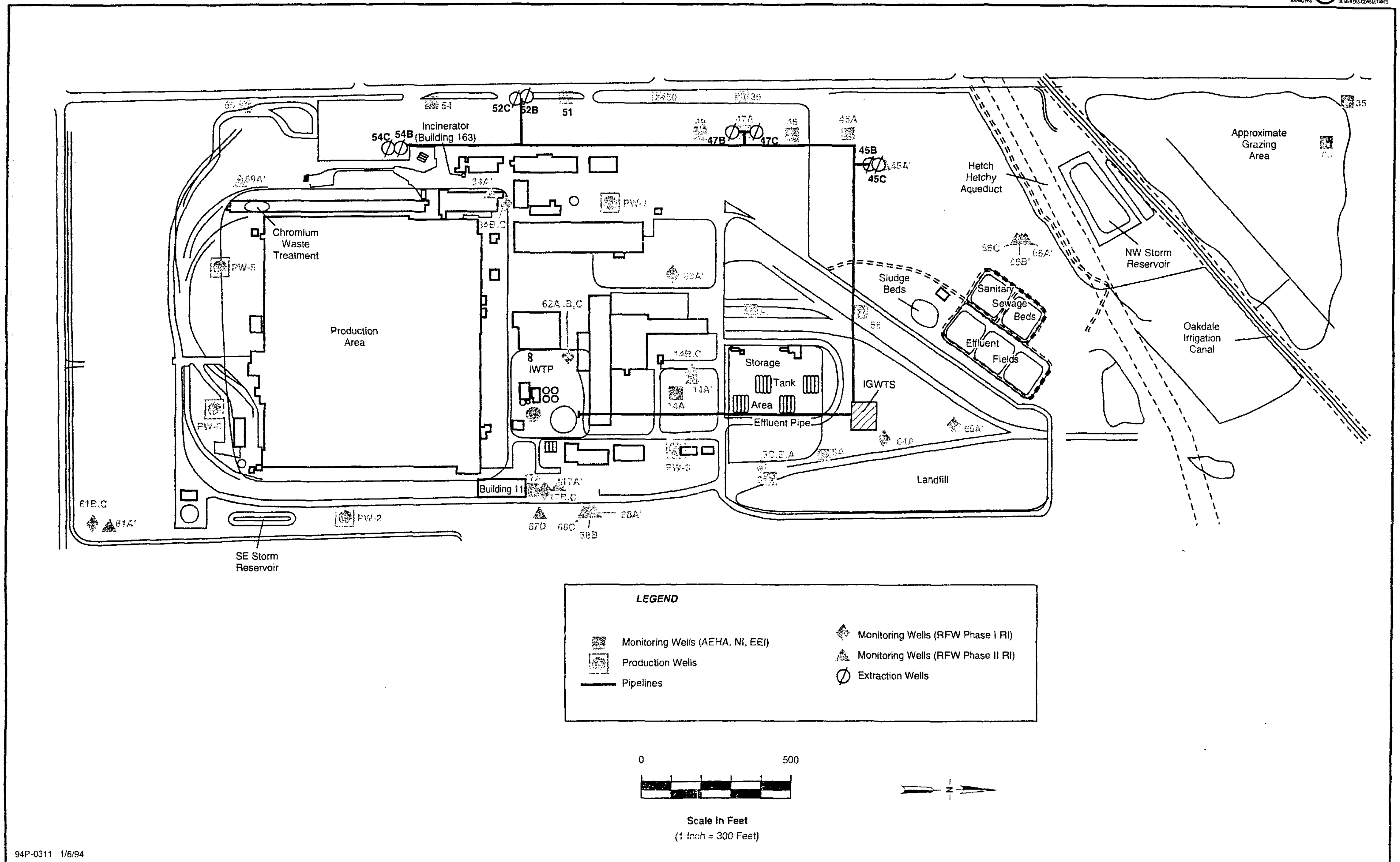


FIGURE 2-13 ALTERNATIVE 2 - IGWTS EXTRACTION AND DISPOSAL SCHEMATIC

The current system involves treatment in the IGWTS and the IWTP. The IGWTS is located in a prefab building near the landfill, as shown in Figure 2-13. The system is designed to treat groundwater at a design flow rate of 152 gpm. The design basis for influent concentrations of free and total cyanide and hexavalent and total chromium is presented in Figure 2-12.

The groundwater collection system consists of a 9,200-gallon aboveground surge tank and two pumps to transfer the water to the chromium and cyanide reduction/precipitation system. Hydrochloric acid is added to reduce the groundwater pH to between 5 and 6. Ferrous sulfate solution is added in using a metered pump to reduce the hexavalent chromium to the trivalent state and to capture the cyanide as ferrocyanide. The groundwater then flows by gravity into the rapid mix tank, where sodium hydroxide solution is added for pH control to raise the solution pH to 9 for the precipitation of chromium hydroxide and ferrocyanide. Flocculation of the precipitate takes place in a tank equipped with a slow-speed, paddle-type agitator. A polymer is added to the floc tank to promote flocsettling in a tube-type clarifier.

Settled floc is discharged to a sludge decanting tank on sludge density control. Thickened sludge is periodically pumped to the IWTP sludge thickener. Approximately 50 to 100 gallons per day (gpd) of sludge is produced. Supernatant from the decanting tank is recycled to the rapid mix tank. The dewatered sludge is containerized and disposed of at a permitted hazardous waste landfill according to the ARARs presented in Table 2-1.

Clarified groundwater from the overflow weir is collected in a chemical addition tank, where further pH adjustment and ferrous sulfate addition are accomplished as required to convert any remaining free cyanide to ferrocyanide prior to ion exchange treatment.

The groundwater is pumped on level control through one of two parallel-pressure sand filters to remove any ferrous hydroxide formed in the chemical addition tank. Filter backwash solids are collected, thickened, and periodically pumped into a tank for transfer to the IWTP sludge thickener. The filtered water then passes through two ion exchange units operated in the series mode. The ferrocyanide anions are adsorbed by the strongly basic anion exchange resin in the two units, and the treated groundwater is discharged into a neutralization tank for pH adjustment prior to discharge into a treated groundwater surge tank. Treated groundwater is then discharged to the IWTP for further treatment.

When the resin in the lead ion exchanger (first bed) is exhausted (saturated with ferrocyanide), the bed is taken off-line for regeneration and the second bed becomes the lead bed treating the filtered water. Regeneration is effected with a total of four bed volumes of 15% sodium chloride solution, after which the resin is rinsed with plant water before the unit is put on-line in the second bed position. The first two-bed volumes of spent regenerant (containing more than 95% of the eluted ferrocyanide) are collected in a spent regenerant tank for off-site disposal. The second two-bed volumes are collected in a recycle tank and reused as the lead portion of sodium chloride solution during the next regeneration.

Approximately 14,000 gallons of spent regenerant containing approximately 2% of sodium ferrocyanide ($Na_4Fe(CN)_6$) is produced each year. This concentrated solution is shipped off-site to a RCRA-permitted treatment facility for cyanide destruction by wet air oxidation.

As mentioned previously, the treated effluent from the IGWTS is transferred to the equalization basin of the IWTP for further treatment. This additional treatment, which consists of flocculation and clarification, is necessary due to concentrations of iron, manganese, and sulfate that periodically exceed the current discharge permit levels for the E/P ponds. The elevated concentrations of these chemicals result from the ferrous sulfate that is added to the IGWTS. Once the additional treatment of the groundwater is performed at the IWTP, the effluent is able to meet discharge requirements.

2.12.3 Alternative 3: Increased Extraction With Treatment at the IGWTS and IWTP

Alternative 3 utilizes the same groundwater treatment system as Alternative 2; however, the extraction system is upgraded to handle increased volumes of extracted groundwater.

Alternative 3 also incorporates the long-term groundwater monitoring program described in Alternative 1. The monitoring program will consist of sampling monitor wells and select residential wells for the contaminants of concern. Only residential wells within the plume boundaries will be sampled since these wells may be used for irrigation purposes. The wells will be monitored throughout the entire remedial action. For this alternative, groundwater is extracted from the A′ aquifer zone as well as from the B and C aquifer zones. The upgraded extraction system is discussed in detail below.

The minimum total extraction rate necessary to capture the contaminant plumes in all three of the affected aquifer zones beneath the site is estimated (for costing purposes) to be 120 gpm. Extraction of the groundwater at this rate can be achieved using a combination of on-site and off-site wells. The system was also evaluated at a total extraction rate of 240 gpm. This extraction rate would also provide adequate capture in all three aquifer zones using a combination of on-site and off-site extraction wells. The proposed locations for extraction wells and additional monitor wells are presented in Figures 2-14 through 2-16. These extraction wells and monitor well locations are not final and may change as more field data are collected during the Remedial Design/Remedial Action (RD/RA) phase of the cleanup.

The extraction rate analyses referenced above illustrate that a range of extraction rates and the placement of extraction wells in various locations can be used to capture the contaminant plumes in the groundwater at RBAAP. However, in order to accomplish the objective of evaluating alternatives using a cost comparison, it is necessary to select specific extraction rates so that a preliminary design can be developed and associated cost estimates determined. Therefore, the 120-gpm extraction rate, which is the minimum extraction rate that is expected to adequately capture the contaminant plumes, was evaluated and is known as Option A. The 240-gpm extraction rate, which represents twice the estimated minimum extraction rate necessary to capture the contaminant plumes, is referred to as Option B. It is assumed that the difference in costs for the construction of on-site extraction wells or a combination of on-site and off-site extraction wells will be negligible; therefore, these scenarios are not evaluated separately in this section. Actual extraction and treatment rates

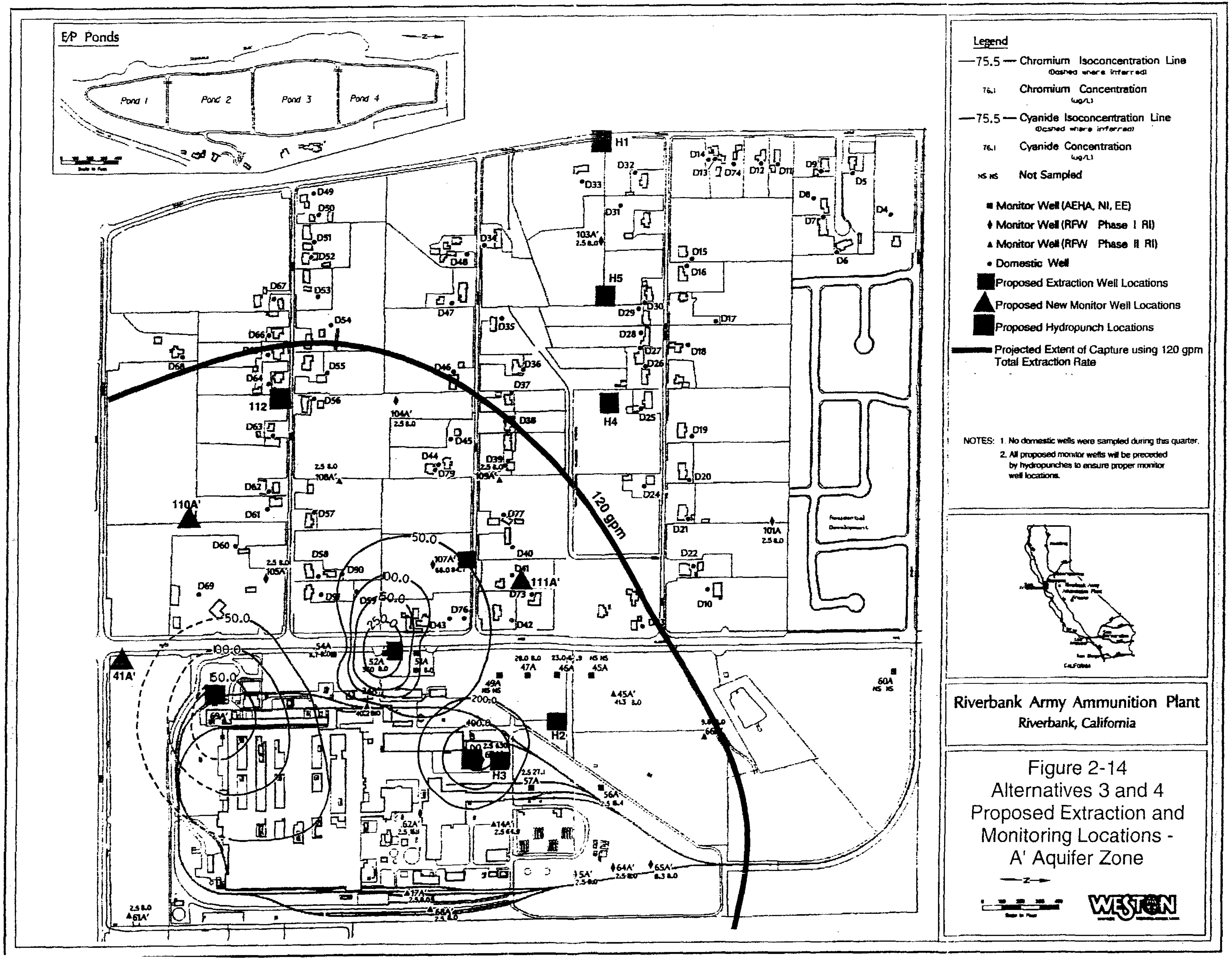


Figure 2-14
Alternatives 3 and 4
Proposed Extraction and
Monitoring Locations -
A' Aquifer Zone

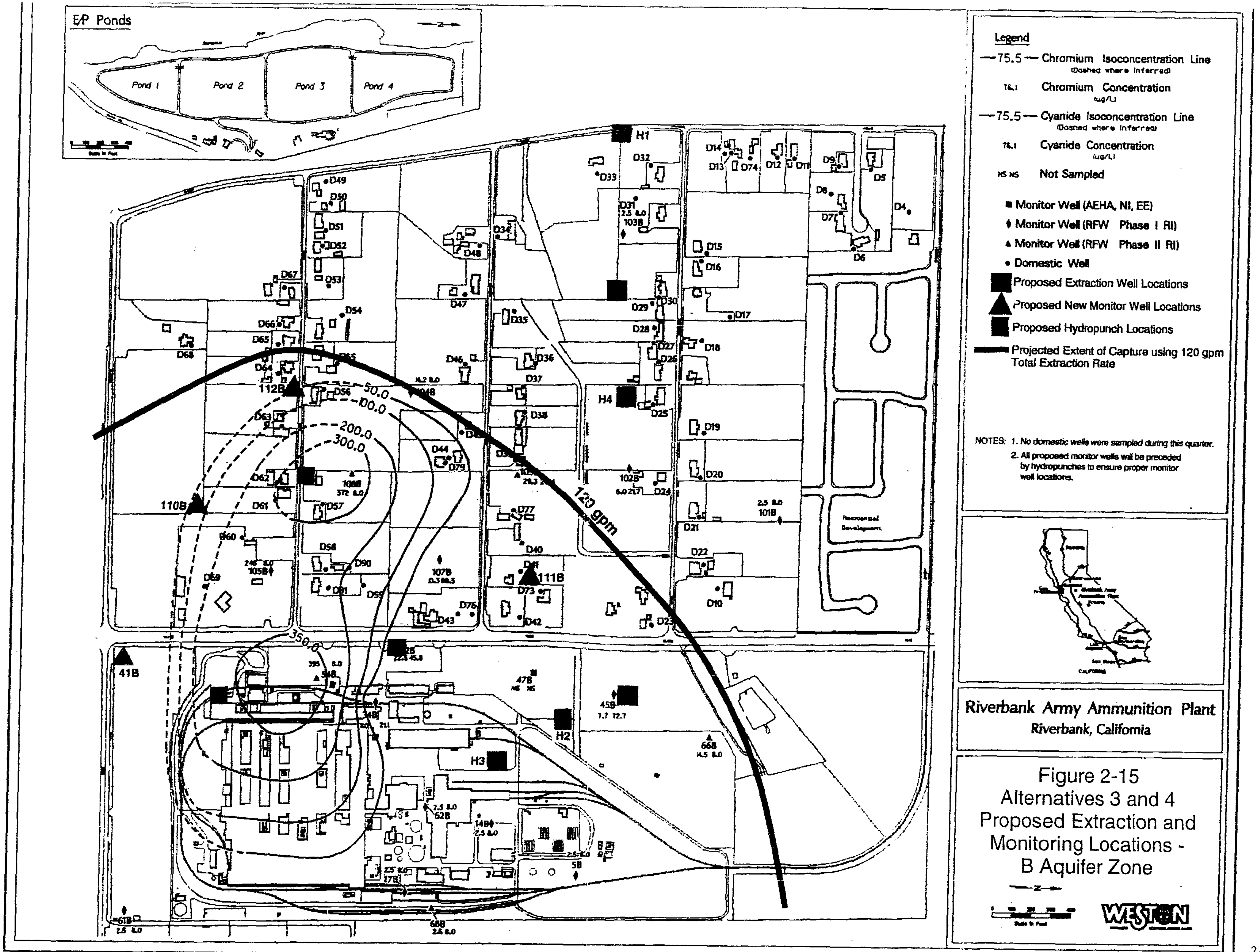


Figure 2-15
Alternatives 3 and 4
Proposed Extraction and
Monitoring Locations -
B Aquifer Zone

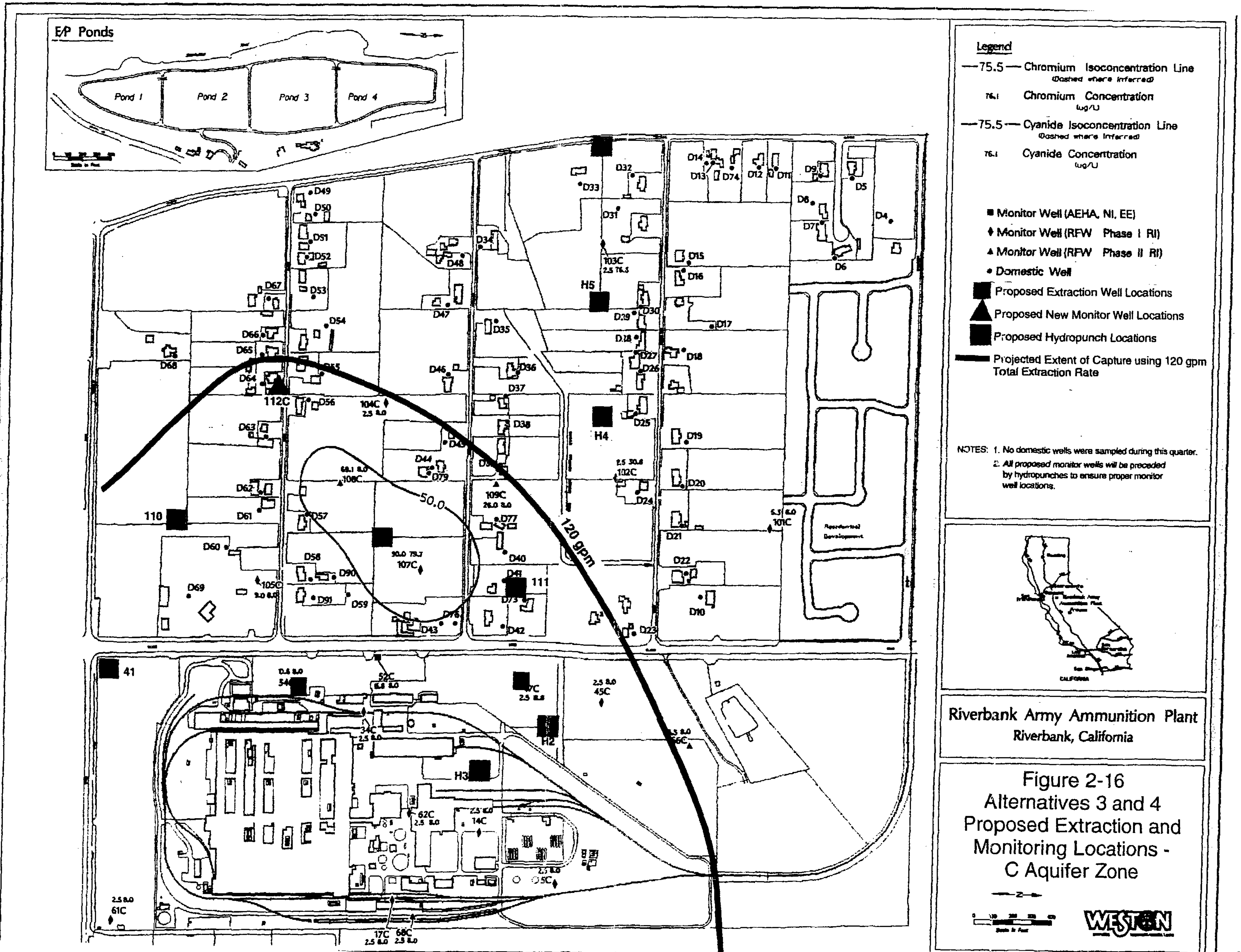


Figure 2-16
Alternatives 3 and 4
Proposed Extraction and
Monitoring Locations -
C Aquifer Zone

necessary to fully capture the chromium and cyanide plumes will be designed into the system as determined during the remedial design effort.

The extracted groundwater will be pumped to the existing IGWTS. The treatment of groundwater at the IGWTS and IWTP is discussed in detail in Subsection 2.12.2. As shown in Figure 2-12, the IGWTS was constructed based on a design rate of 152 gpm. Therefore, the IGWTS cannot handle an influent flow rate greater than 152 gpm. It is assumed that if an extraction rate greater than 152 gpm is chosen for remediation of the groundwater, an identical treatment system will be constructed adjacent to the IGWTS. The cost of constructing the additional treatment system is presented with the cost of Option B (240-gpm extraction rate).

2.12.4 Alternative 4: Increased Extraction and Treatment Using a New Treatment System

Alternative 4 involves the expansion and modification of the existing extraction scheme and the IGWTS to accommodate additional extraction wells, a new chromium removal unit, and an iron and manganese removal unit. With these treatment changes, contaminant concentrations will be reduced and the effluent from the new treatment system will be of adequate quality for discharge without additional treatment in the IWTP. A process schematic of the expanded treatment system is shown in Figure 2-17. Alternative 4 also incorporates the long-term groundwater monitoring program described in Alternative 1. A brief description of the treatment system is provided below.

The evaluation of groundwater extraction for the new system will utilize the same extraction rates as illustrated in Alternative 3. A detailed description of the extraction system was presented in Subsection 2.12.3.

The extraction rate analyses illustrate that a range of extraction rates and the proposed placement of extraction wells in various locations (as shown in Figures 2-14 through 2-16) can be used to capture the contaminant plumes in the groundwater at RBAAP. However, in order to accomplish the objective of evaluating alternatives using a cost comparison, it

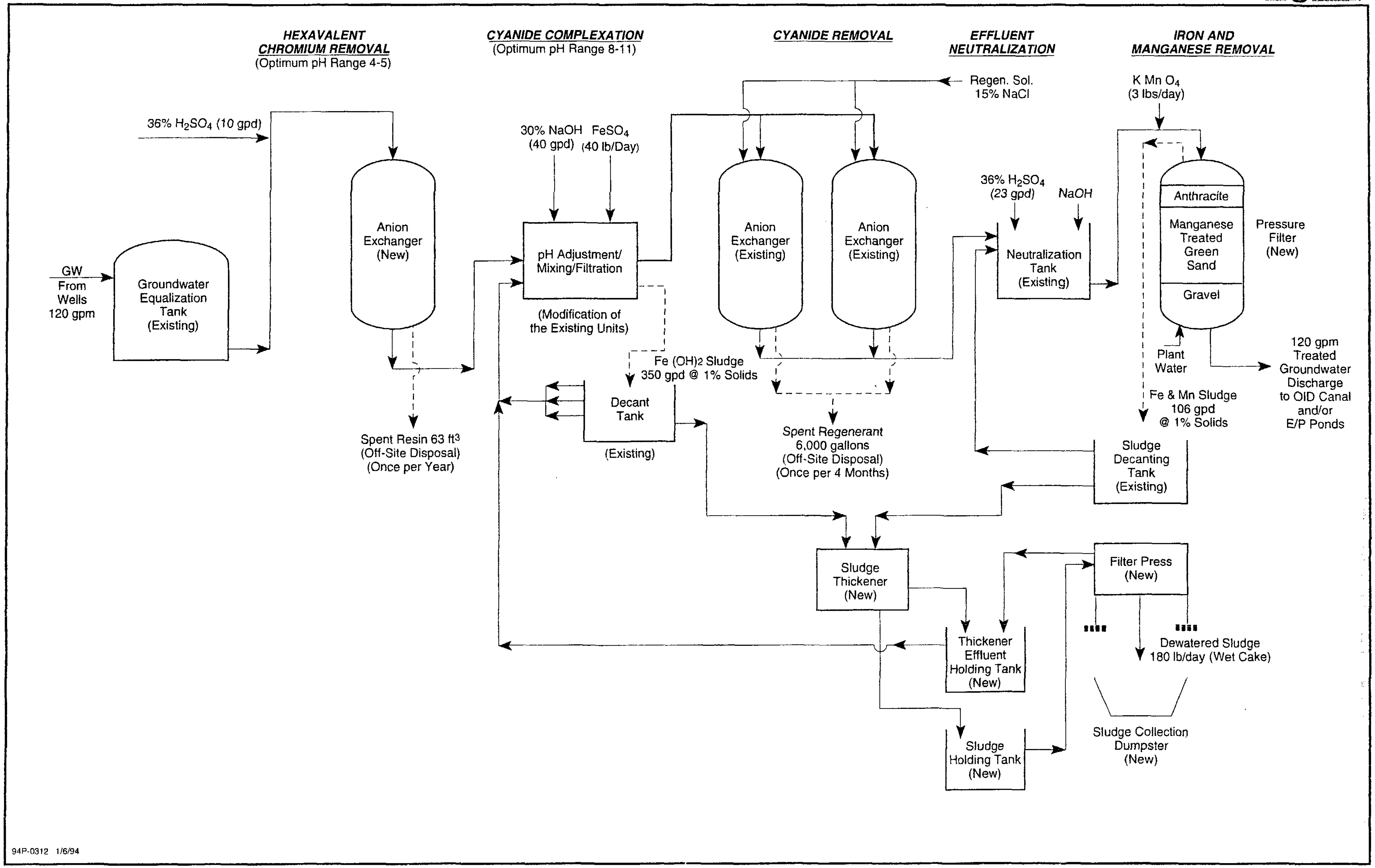


FIGURE 2-17 EXPANDED TREATMENT SYSTEM PROCESS FLOW SCHEMATIC

is necessary to select specific extraction rates so that a preliminary design can be developed and associated cost estimates determined. Therefore, the 120-gpm extraction rate, which is the minimum extraction rate that will adequately capture the contaminant plumes, was evaluated and will be known as Option A. The 240-gpm extraction rate, which represents twice the minimum extraction rate necessary to capture the contaminant plumes, is referred to as Option B. It is assumed that the difference in costs for the construction of extraction wells at different locations and in varying combinations will be negligible; therefore, these scenarios are not evaluated separately in this section.

The extracted groundwater will enter the treatment system through the existing groundwater equalization tank. A new transfer pump will be added in-line with the two existing pumps that will transfer groundwater from the equalization tank to the existing chromium and cyanide reduction tank. The reduction tank would now be used as a pH adjustment tank, where the existing hydrochloric acid dosing system will lower the groundwater pH to between 4 and 5.

After pH adjustment, the groundwater will be transferred to a new anion exchanger. This exchanger will contain a resin that will specifically remove hexavalent chromium from the groundwater. The anion exchanger will be a nonregenerable unit, with an estimated resin life of 1 year. The spent resin (approximately 63 ft^3) will be disposed of once per year in an approved off-site facility. The effluent from the anion exchanger will flow to the existing chemical addition tank, which is part of the cyanide removal unit.

The existing cyanide complexation and removal unit, consisting of a chemical addition tank, two pressure filters, and two anion exchangers, will be used in the expanded system. The only modifications will be a new pressure filter in parallel to the existing filters and an additional filter feed pump (for standby purposes). These modifications will be performed to better accommodate the range of flow rates. The existing anion exchangers have sufficient capacity to handle a maximum flow rate of 152 gpm.

The pressure filters remove the ferrous hydroxide ($Fe(OH_2)$) sludge that is formed during cyanide complexation. The filters will be periodically backwashed with plant water, and the backwash will go to an existing decant tank. After settling, the sludge will be pumped to a new sludge thickener and the supernatant will be returned to the cyanide unit chemical addition tank.

For the anion exchangers, it is estimated that the beds will require regeneration (using 15% NaCl solution) once every 4 months. Approximately 6,000 gallons of spent resin every 4 months will be generated. This spent resin will be shipped off-site to an approved facility for treatment/disposal.

Effluent from the cyanide removal unit will flow to the existing neutralization tank. The existing acid and caustic dosing systems will be used to neutralize the treated groundwater.

The current IGWTS may periodically exceed the secondary MCLs for iron, manganese, and sulfate prior to treatment in the IWTP. The sulfate concentrations will be greatly reduced by the reduction in ferrous sulfate usage in the treatment system. To eliminate additional treatment in the IWTP, an iron and manganese removal unit is necessary to reduce these chemicals to levels acceptable for discharge. Dissolved iron and manganese will be oxidized to ferric and manganese oxides using a potassium permanganate ($KMnO_4$) solution that will be continuously fed to the effluent from the neutralization tank. The oxidized iron and manganese will be removed by a pressure filter containing anthracite filter media and manganese-treated greensand. The treated groundwater will then flow to the existing treated groundwater surge tank.

Backwashing of the filter will occur to remove the iron and manganese sludge. The backwash will be collected in an existing sludge decanting tank (from the former chromium reduction/precipitation unit). The settled sludge will be pumped to the new sludge thickener, and the supernatant will be returned to the neutralization tank.

Thickened sludge from the cyanide unit and from the iron and manganese units will be dewatered in a new filter press. The resultant filter cake will go through the paint filter and Toxicity Characteristic Leachate Procedure (TCLP) tests to determine whether or not the cake is hazardous. The cake will then be disposed of in an approved off-site facility and will comply with state and federal laws, as appropriate (see Table 2-1). It is estimated that approximately 180 pounds per day (lb/day) of wet cake at 25% solids concentration will be generated. The supernatant from the thickener and the filtrate from the filter press will be returned to the chemical addition tank at the beginning of the treatment process.

The effluent from the treatment system will be continuously monitored using on-line analyzers. If the chromium and/or cyanide concentrations exceed the discharge limits, an alarm will sound and the treatment system will automatically shut down. All spent media from the filters and exchangers will be regenerated/replaced, as necessary, before the system will be put back on-line.

Although extensive modifications to the existing treatment system will be performed for this alternative, the new treatment system will only be capable of handling a total extraction rate of 152 gpm. Extraction rates greater than 152 gpm will require a second treatment system, identical to the first system, to be installed to treat the additional flow. Option B, which represents a 240-gpm total extraction rate, will be used to evaluate the construction and operation of a second treatment system in parallel with the initial system.

It is expected that the system will be in operation for 10 years after startup of the system. An annual review of the treatment system will be performed to determine the overall efficiency of the system.

2.13 SUMMARY OF COMPARATIVE ANALYSIS OF GROUNDWATER EXTRACTION AND TREATMENT ALTERNATIVES

2.13.1 Threshold Criteria

2.13.1.1 Overall Protection of Human Health and the Environment

Alternatives 3 and 4 provide the greatest amount of protection of human health and the environment. These alternatives actively remediate all three of the affected aquifer zones to the remedial action objectives.

Alternative 2 provides protection for the B and C aquifer zones. However, this alternative does not address the contaminant plumes in the A′ aquifer zone.

Alternative 1 does not provide protection of human health and the environment since no remedial measures are performed under this alternative.

2.13.1.2 Compliance With ARARs

Alternative 1, No Action With Institutional Controls, does not actively address the state MCLs of 50 μg/L for chromium and 200 μg/L for cyanide in the groundwater.

Alternative 2, Continued Extraction and Treatment Utilizing the IGWTS and IWTP, does not actively attain the state MCLs in the B and C aquifer zones. The groundwater model predicts that the extraction system does not adequately capture the groundwater in these aquifer zones. However, if modifications were performed on the pumping rates from each well to reflect local transmissivities, adequate capture may be attained. In either case, the state MCLs are not actively achieved in the A′ aquifer zone since no extraction wells are screened in this aquifer zone.

Alternative 3, Increased Extraction With Treatment at the IGWTS and IWTP, and Alternative 4, Increased Extraction and Treatment Using a New Treatment System, most actively achieve the state MCLs in all three aquifer zones through active pumping in all affected aquifer zones and treatment of the groundwater to concentrations adequate for discharge.

The ARARs related to these alternatives are presented in Table 2-1.

2.13.2 Primary Balancing Criteria

2.13.2.1 Long-Term Effectiveness and Permanence

Alternative 1 only reduces risk by natural attenuation. Long-term monitoring will be used to observe groundwater conditions and to provide an early warning device for any potential remaining users of the groundwater downgradient of the site.

Alternative 2, with modifications to pumping rates, will reduce the risks from contaminants in the B and C aquifer zones. However, the risks in the A' aquifer zone will not be reduced.

Alternatives 3 and 4 address the long-term risks in all three aquifer zones through active remedial measures. Remedial action objectives will be met in all aquifer zones under these alternatives.

Although the possibility is considered unlikely, the dewatered A aquifer zone may recharge in the future. Regardless of which alternative is selected, additional remedial actions may be necessary if this recharge occurs, as discussed in Subsection 2.19.1.

2.13.2.2 Reduction of Toxicity, Mobility, and Volume of Contaminants

Alternative 1 will reduce the toxicity of contaminants through natural attenuation only. The mobility and volume of the contaminants will not be reduced under this alternative.

If modifications to the pumping rates are performed, Alternative 2 will curtail the mobility of the contaminants in the B and C aquifer zones. The volume and toxicity of the contaminants will be greatly reduced in the treatment processes. However, the toxicity, mobility, and volume of contaminants in the A′ aquifer zone will not be reduced.

Alternatives 3 and 4 accomplish a significant reduction in the mobility in all three aquifer zones. Each treatment system is expected to greatly reduce the volume and toxicity of the contaminants in the extracted groundwater for each of these alternatives.

2.13.2.3 Short-Term Effectiveness

Alternative 1 does not actively mitigate the contaminant plumes; risks remain in the groundwater.

Alternatives 2, 3, and 4 have generally the same short-term risks relating to operation of the treatment systems. Additional short-term risks for Alternatives 3 and 4 involve the construction of new extraction wells and modifications to the existing treatment system. If Option B of Alternatives 3 and 4 is required, treatment systems identical to the system in the respective alternatives must be constructed to handle the additional flows.

2.13.2.4 Implementability

Alternatives 1 and 2 do not require additional activities for implementation. Alternative 1 involves the monitoring of groundwater as the only activity. Alternative 2 is currently operating at the site. The only activities would be modification to the extraction well pumping rates.

Alternative 3 involves the construction of new extraction wells, and under Option A, the continued operation of the IGWTS and IWTP. If increased extraction is necessary, then Option B would be implemented. This option consists of the construction of an identical IGWTS to handle the additional flow. All construction will use conventional construction techniques and well-proven technologies.

Option A of Alternative 4 involves modifications to the existing treatment system and the construction of extraction wells. Option B, which would be necessary if an increased extraction rate is specified, would also require an identical treatment system to be built to handle the additional flow.

2.13.2.5 Cost

The present worth cost for the preferred alternative is $6,454,000 (Alternative 3, Option A). The lowest-cost alternative is Alternative 1 at $2,338,000. The highest-cost alternative is Alternative 4 at $11,850,000 (Option B). Alternative 2 has a present worth cost of $5,737,000.

2.13.3 Modifying Criteria

2.13.3.1 EPA/CA EPA Acceptance

EPA and CA EPA, along with the Army, have concurred with the choice of Alternative 3.

2.13.3.2 Community Acceptance

Public comments on the selected remedial actions were addressed at the public meeting on 31 August 1993. No other comments were received during the public comment period.

The public reaction to the selected groundwater alternative was generally favorable. The main concerns voiced by the community included the placement of extraction wells off-site and the operation of the extraction system. These issues are addressed in detail in Section 3.

2.14 DESCRIPTION OF LANDFILL ALTERNATIVES

2.14.1 Alternative 1: No Action With Institutional Controls

Alternative 1 does not involve active remedial measures. (Prior to the DRA, the pot liner material and arsenic in the soils were considered by the Army as the only contaminants of concern at the landfill.) Access and deed restrictions will be implemented for the southern portion of the landfill to prevent current and future exposure to the material. These restrictions will be easily implemented since the pot liner material is highly localized, well-defined, and present in a relatively small quantity.

2.14.2 Alternative 2: Excavation and Off-Site Treatment and Disposal

Alternative 2 involves the excavation and off-site disposal of the pot liner material in a RCRA-approved landfill. This alternative does not address the risks related to arsenic in the landfill soils under the hypothetical future residential use scenario. The following summarizes the major tasks involved in this alternative:

- Segregation and excavation of pot liner material. Small pieces (i.e., chips) that cannot be excavated in bulk will be removed with surrounding soils. All excavated materials will be treated as hazardous waste.
- Installation of geotextile silt fences or other surface water management devices as deemed appropriate and necessary to control off-site transport.
- Dust monitoring.
- Backfilling with clean soil (if necessary), regrading, and revegetation of excavated areas.

2.14.3 Alternative 3: Final Cover

The final cover alternative was developed as a result of the DRA. For reference purposes, the entire text of the DRA has been included in Appendix A. As stated in the DRA, the Army agreed to: 1) install a final cover, using to the extent possible soils from the installation to reduce capital costs; 2) maintain the final cover for a period of 20 years; and 3) install additional monitor wells downgradient of the landfill. The 5-year review process under CERCLA, and as described in the RBAAP FFA, will be used to evaluate if continued maintenance of the cover is necessary to protect human health and the environment, including water quality. The Army has agreed to take the position that continued maintenance of the final cover for a 20-year period is necessary for the protection of human health and the environment, including water quality.

Under the DRA, the parties agree to the substantive requirements of Title 23 CCR, Chapter 15, Articles 5 and 8, Corrective Action and Closure Requirements. Based on the discussion during the Dispute Resolution process, the parties agreed that this alternative for the landfill will be incorporated as the recommended landfill remedy. In order to resolve the dispute, the parties agreed to the language below, without making a determination as to whether Chapter 15 is an ARAR. The following specifics were agreed to:

- A foundation soil layer of sufficient stability will be provided by grading and compacting existing landfill soils.
- A 1-ft-thick layer will be installed consisting primarily of clays from a clean source on the installation. The clay source will be supplemented, as necessary, by off-site clays to produce a clay layer with design permeability of 1×10^{-6} cm/sec.
- Geotechnical data will be collected from a clean source at the installation to determine the appropriate ratio of on-site to off-site clays to achieve a design permeability of 1×10^{-6} cm/sec.
- A minimum of 1 ft of clean topsoil will be placed over the clay layer to provide an adequate rooting depth for vegetative cover and protection of the clay layer.
- The final cover will be designed with the objective of minimizing maintenance.
- The final cover will be graded to provide a minimum of 2% slope to minimize ponding of precipitation and provide adequate drainage.
- The final cover will be constructed in accordance with an approved CQAP.

- The final cover will be maintained to ensure its integrity for a period of 20 years.
- A 5-year review process will be used to evaluate whether continued maintenance of the cover is necessary to protect human health and the environment, including water quality.
- One to two additional monitor wells will be installed downgradient of the landfill at the point of compliance.

Installation of the final cover on the landfill also addresses the risks presented by elevated arsenic levels in the soils under a hypothetical future residential use scenario. However, since the soils will remain in place at the landfill, access and deed restrictions will also be implemented for the landfill area. These restrictions will prevent exposure to the landfill soils after the final cover maintenance period has ended.

2.15 SUMMARY OF COMPARATIVE ANALYSIS OF LANDFILL ALTERNATIVES

2.15.1 Threshold Criteria

2.15.1.1 Overall Protection of Human Health and the Environment

Landfill Alternative 3 would provide adequate protection to human health and the environment by preventing further migration of chromium in the soils to the groundwater and by preventing exposure to the pot liner material (which contains cyanide) and to the landfill soils (which contain arsenic). Landfill Alternative 1 does not prevent chromium migration, nor does it prevent exposure to the pot liner material or the landfill soils. Landfill Alternative 2 eliminates the exposure to the pot liner material, but does not prevent potential migration of chromium or exposure to landfill soils.

2.15.1.2 Compliance With ARARs

No ARARs are associated with Landfill Alternative 1 since the pot liner material is not disturbed and no chemical-specific ARARs are exceeded. For Landfill Alternative 2, RCRA hazardous waste requirements will be met since the pot liner material is considered a

RCRA hazardous waste upon excavation. Disposal of the pot liner material will also comply with all state and federal RCRA requirements.

Landfill Alternative 3 meets the substantive provisions of Title 23, CCR Chapter 15, Articles 5 and 8 as resolved under the DRA. Landfill Alternative 3 also meets the substantive requirements of RCRA and other state and federal laws. Although Landfill Alternative 3 does not directly address the pot liner material, the material would not be regulated under RCRA unless it is excavated. The covering of the material would follow RCRA regulations, including RCRA closure requirements.

No waiver from the ARARs is necessary to implement Landfill Alternative 3. The ARARs related to the landfill alternatives are presented in Table 2-2.

2.15.2 Primary Balancing Criteria

2.15.2.1 Long-Term Effectiveness and Permanence

Landfill Alternative 3 will serve to ensure that no risks occur as a result of exposure to the pot liner material or landfill soils. Landfill Alternative 1 does not prevent exposure to the landfill, and Landfill Alternative 2 prevents risks to the pot liner material only.

2.15.2.2 Reduction of Toxicity, Mobility, or Volume of the Contaminants Through Treatment

Only Landfill Alternative 2 would use treatment to reduce the toxicity and mobility of the contaminants, specifically the pot liner material. Landfill Alternative 3 would cover the landfill soils, but does not address treatment of the soils as a preferred method.

2.15.2.3 Short-Term Effectiveness

Landfill Alternatives 2 and 3 would involve short-term risks due to earth-moving activities at the landfill. An on-site air monitoring program would be established to monitor air quality during these activities. In addition, adequate safety practices will be used to deal with the construction hazards related to these alternatives.

2.15.2.4 Implementability

Each of the landfill alternatives would have few associated technical or administrative difficulties that would impede implementation. Landfill Alternative 1 requires only access and deed restrictions to be placed on the landfill. Landfill Alternatives 2 and 3 would employ conventional construction and engineering practices. Landfill Alternative 3 would require a 20-year maintenance period; the other alternatives would not require maintenance.

2.15.2.5 Cost

The present worth cost for Landfill Alternative 3 is $405,000. Landfill Alternative 1 does not have any cost associated with it, whereas Landfill Alternative 2 has a present worth cost of $508,000.

2.15.3 <u>Modifying Criteria</u>

2.15.3.1 Federal and State Acceptance

EPA and CA EPA, along with Army, have concurred with the selection of Landfill Alternative 3.

2.15.3.2 Community Acceptance

Public comments on the selected remedial actions were addressed during the public meeting on 31 August 1993. No other comments were received during the public comment period. No public comments discussed during the public meeting were directly related to the landfill alternatives.

2.16 SELECTED REMEDIES

The selected remedies for the remedial actions at RBAAP are:

- Groundwater Remedial Action - Alternative 3: Increased Extraction With Treatment at the IGWTS and IWTP. This remedial action also includes the discharge of treated groundwater to the OID Canal and the E/P ponds.
- Landfill Remedial Action - Alternative 3: Final Cover.

The selected remedies are discussed further in the following subsections.

2.16.1 Groundwater Remedy

Based upon CERCLA requirements, the detailed analysis of alternatives, and public comments, EPA, in consultation with CA EPA-DTSC, CA EPA-RWQCB, and the Army, has determined that Alternative 3: Increased Extraction With Treatment at the IGWTS and IWTP, is the most appropriate remedy for groundwater remediation at RBAAP. In addition, the treated groundwater would be discharged to the OID Canal and the E/P ponds, where the OID Canal is the preferred discharge location.

Alternative 3 involves upgrading the current extraction system at RBAAP to handle flows from the A′, B, and C aquifer zones and implementing a long-term groundwater monitoring program for chromium and cyanide contamination. The monitoring program will consist of sampling monitor wells and select residential wells. Only residential wells within the plume boundaries will be sampled since these wells may be used for irrigation purposes. The wells will be monitored throughout the entire remedial action.

The minimum total extraction rate necessary to capture the contaminant plumes in the affected aquifer zones is estimated to be 120 gpm. The extraction will be performed through a combination of on-site and off-site extraction wells. The specific extraction rate and number and locations of extraction wells necessary to fully capture the chromium and cyanide plumes will be determined during the remedial design. Modifications to the design may be necessary during the remedial action in order to optimize the extraction system. The proposed extraction well and monitor well locations are presented in Figures 2-18 through 2-20. These locations are not final and are subject to change during the RD/RA stage of the cleanup.

In accordance with the Dispute Resolution Agreement, field data and modeling will be used to aid in the design and optimization of the final groundwater extraction and treatment system to achieve full plume capture within 1 year of full system operation. Full plume capture will be demonstrated by an adequate monitor well network.

In addition, the Army will revise the current model to adequately address all regulatory agency comments during the RD/RA phase. The purpose of this revision will be to provide a more effective model that will lessen the cost and time needed to design the full-scale system and to achieve remediation goals. Revision of the model must be contingent upon agreement (between the parties) that the revision will achieve its stated purpose.

Since various extraction rates can be used for plume capture at the site, it is necessary to select specific extraction rates in order to evaluate other alternatives using a cost evaluation. Therefore, the 120-gpm extraction rate, which is the minimum extraction rate that is estimated to adequately capture the contaminant plumes, was evaluated and is known as Option A. The 240-gpm extraction rate, which represents twice the minimum extraction rate estimated to capture the contaminant plumes, is referred to as Option B.

The extracted groundwater will be pumped to the existing treatment system (the IGWTS) at the site. The process flow schematic for this system is shown in Figure 2-21.

The current system involves treatment in the IGWTS and the IWTP. The IGWTS is located in a prefab building near the landfill. The system is designed to treat groundwater at a design flow rate of 152 gpm. The design basis for influent concentrations of free and total cyanide and hexavalent and total chromium is presented in Figure 2-21.

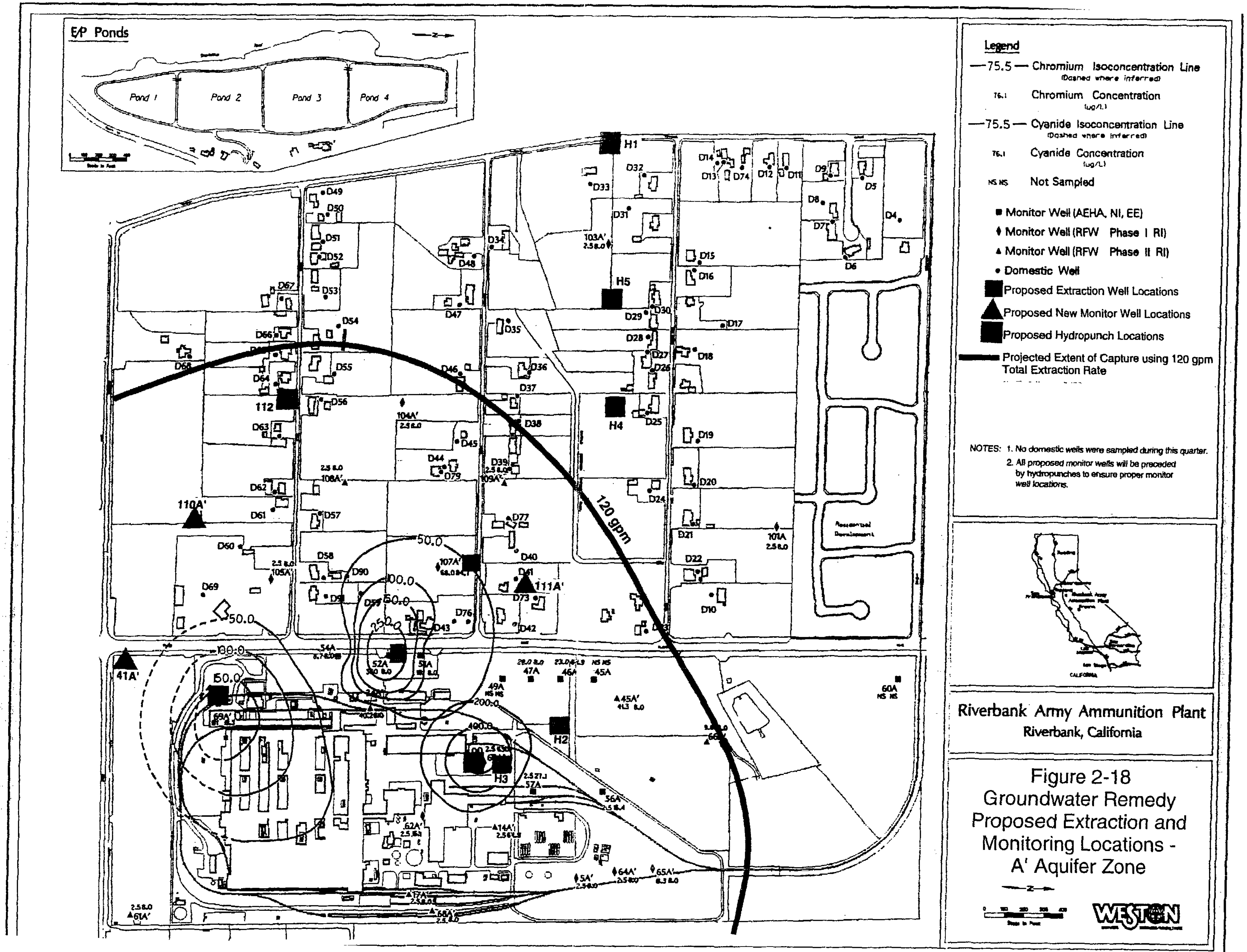


Figure 2-18 Groundwater Remedy Proposed Extraction and Monitoring Locations - A' Aquifer Zone

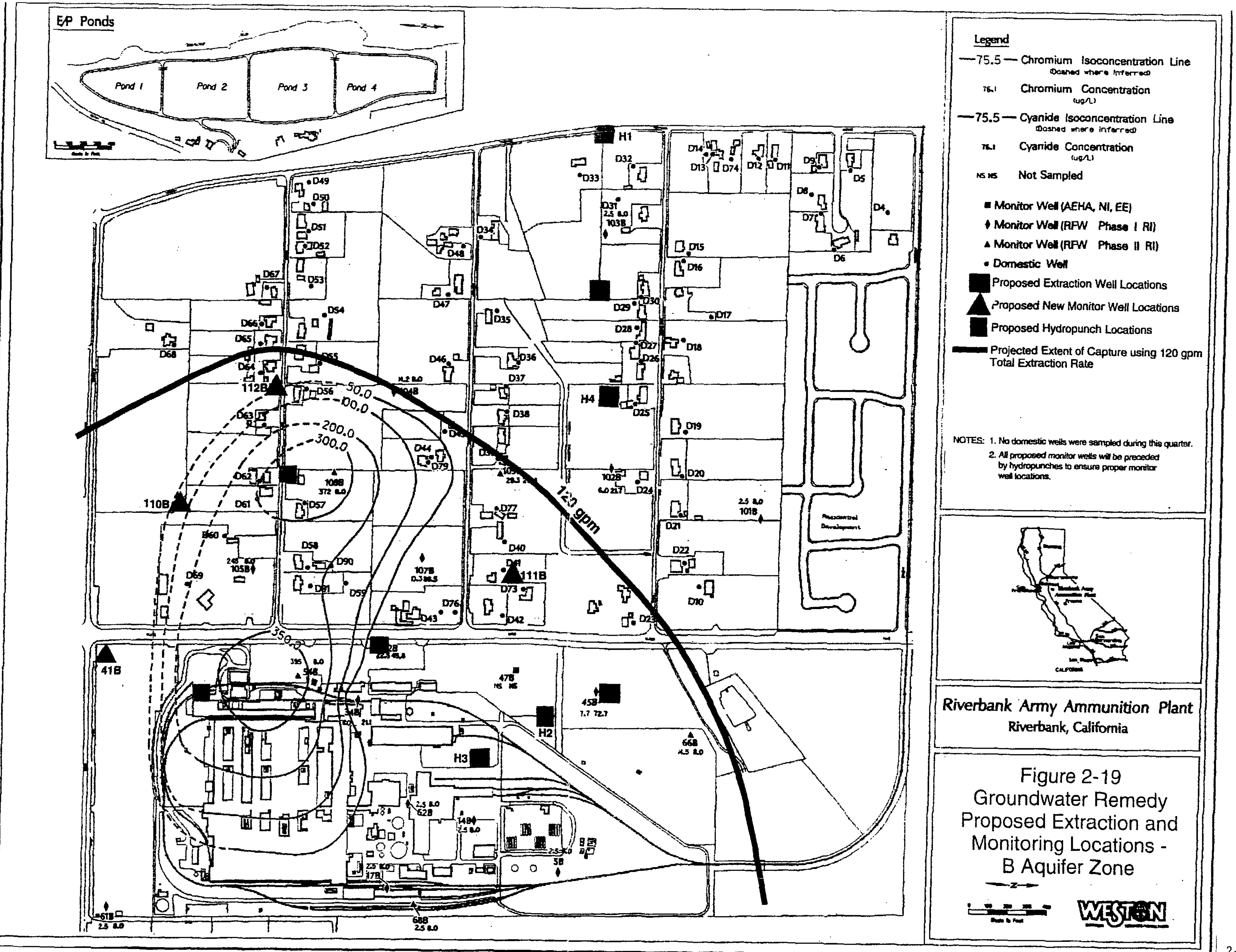


Figure 2-19
Groundwater Remedy
Proposed Extraction and
Monitoring Locations -
B Aquifer Zone

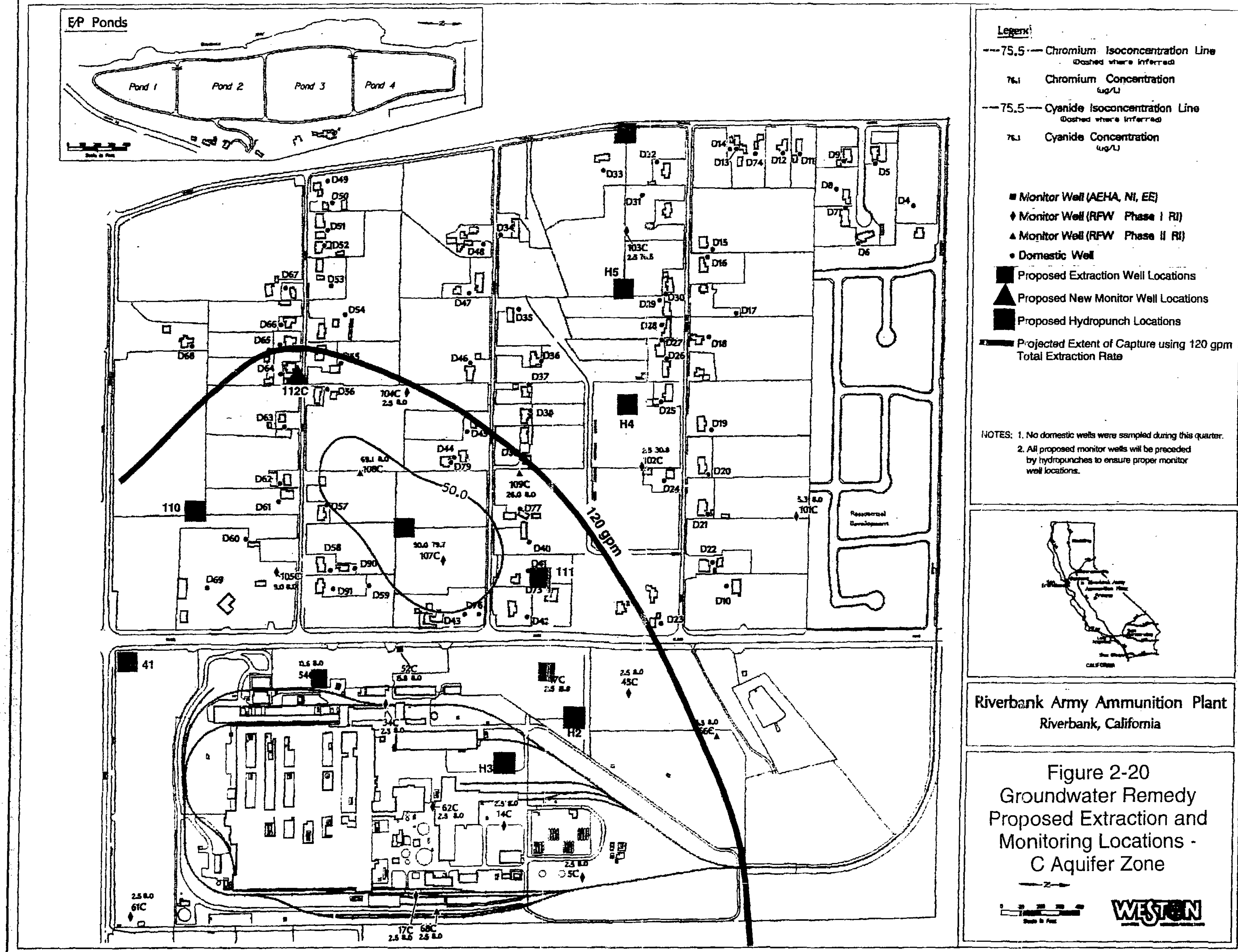
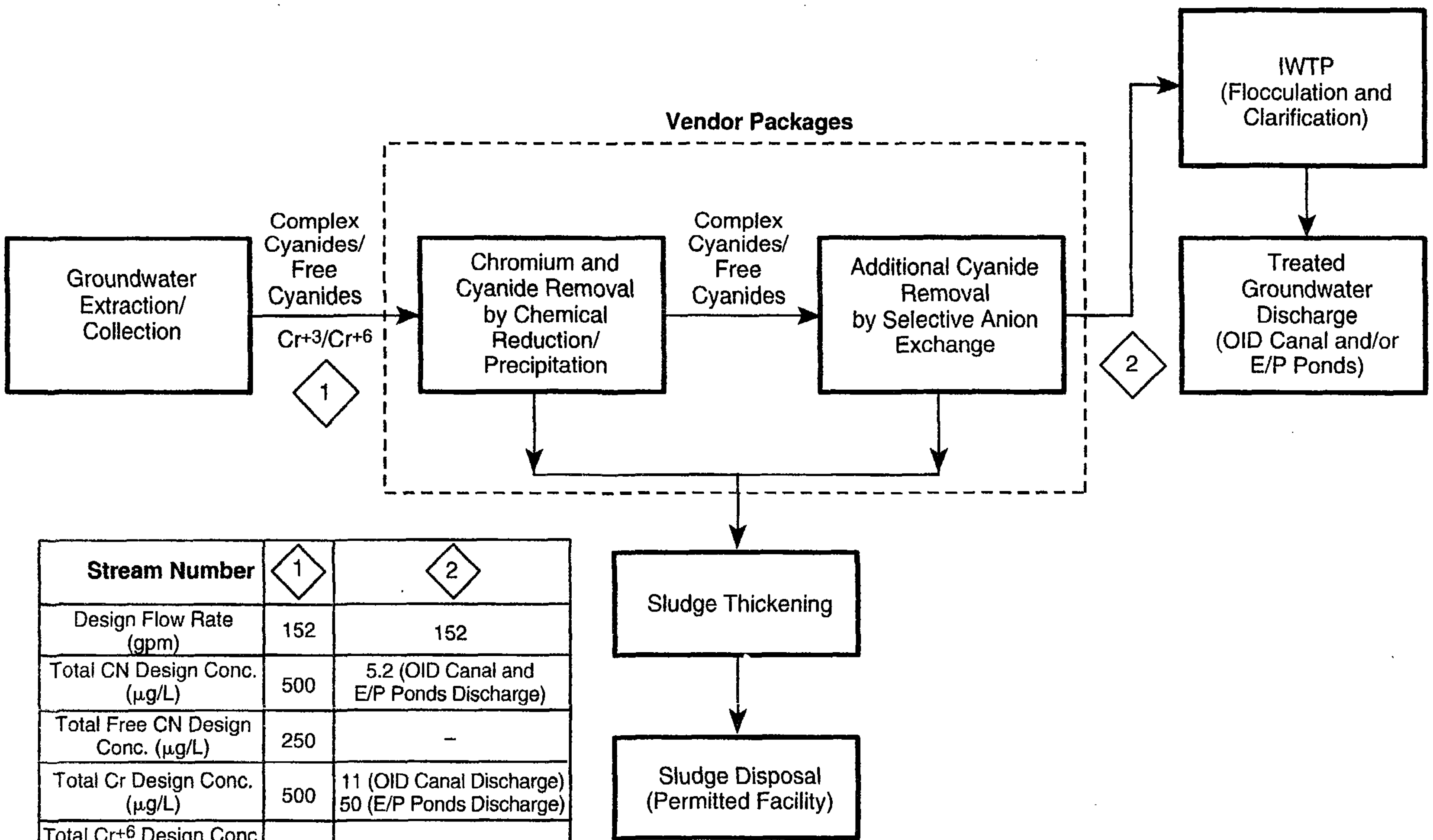


Figure 2-20
Groundwater Remedy
Proposed Extraction and
Monitoring Locations -
C Aquifer Zone



Stream Number	1	2
Design Flow Rate (gpm)	152	152
Total CN Design Conc. (μg/L)	500	5.2 (OID Canal and E/P Ponds Discharge)
Total Free CN Design Conc. (μg/L)	250	–
Total Cr Design Conc. (μg/L)	500	11 (OID Canal Discharge) 50 (E/P Ponds Discharge)
Total Cr^{+6} Design Conc. (μg/L)	250	–

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FIGURE 2-21 GROUNDWATER REMEDY PROCESS FLOW SCHEMTIC

The groundwater collection system consists of a 9,200-gallon aboveground surge tank and two pumps to transfer the water to the chromium and cyanide reduction/precipitation system. Hydrochloric acid is added to reduce the groundwater pH to between 5 and 6. Ferrous sulfate solution is metered in using a metered pump to reduce the hexavalent chromium to the trivalent state and to capture the cyanide as ferrocyanide. The groundwater then flows by gravity into the rapid mix tank, where sodium hydroxide solution is metered in on pH control to raise the solution pH to 9 for precipitation of chromium hydroxide and ferrocyanide. Flocculation of the precipitate takes place in a tank equipped with a slow-speed, paddle-type agitator. A polymer is added to the floc tank to promote floc settling in a tube-type clarifier. Settled floc is discharged to a sludge decanting tank on sludge density control. Thickened sludge is periodically pumped to the IWTP sludge thickener. Approximately 50 to 100 gpd of sludge is produced. Supernatant from the decanting tank is recycled to the rapid mix tank. The dewatered sludge is containerized and disposed of at a permitted hazardous waste landfill according to the ARARs presented in Table 2-1.

Clarified groundwater from the overflow weir is collected in a chemical addition tank, where further pH adjustment and ferrous sulfate addition are accomplished as required to convert any remaining free cyanide to ferrocyanide prior to ion exchange treatment.

The groundwater is pumped on level control through one of two parallel-pressure sand filters to remove any ferrous hydroxide formed in the chemical addition tank. Filter backwash solids are collected, thickened, and periodically pumped into a tank for transfer to the IWTP sludge thickener. The filtered water then passes through two ion exchange units operated in the series mode. The ferrocyanide anions are adsorbed by the strongly basic anion exchange resin in the two units, and the treated groundwater is discharged into a neutralization tank for pH adjustment prior to discharge into a treated groundwater surge tank.

When the resin in the lead ion exchanger (first bed) is exhausted (saturated with ferrocyanide), the bed is taken off-line for regeneration and the second bed becomes the lead bed treating the filtered water. Regeneration is effected with a total of four bed volumes of 15% sodium chloride solution, after which the resin is rinsed with plant water before the unit is put on-line in the second bed position. The first two-bed volumes of spent regenerant (containing more than 95% of the eluted ferrocyanide) are collected in a spent regenerant tank for off-site disposal. The second two-bed volumes are collected in a recycle tank and reused as the lead portion of sodium chloride solution during the next regeneration.

Approximately 14,000 gallons of spent regenerant containing approximately 2% of sodium ferrocyanide ($Na_4Fe(CN)_6$) is produced each year. This concentrated solution is shipped off-site to a RCRA-permitted treatment facility for cyanide destruction by wet air oxidation.

The treated effluent is transferred to the equalization basin of the IWTP for further treatment via flocculation and clarification. This additional treatment is necessary due to concentrations of iron, manganese, and sulfate that periodically exceed the current discharge permit levels for the E/P ponds. The elevated concentrations of these chemicals result from the ferrous sulfate that is added to the IGWTS. Once the additional treatment of the groundwater is performed at the IWTP, the effluent is able to meet discharge requirements set forth by CA EPA, which are presented in Figure 2-21.

Once the groundwater has achieved additional treatment at the IWTP, it will be discharged to either the OID Canal or the E/P ponds. The preference for RBAAP is to discharge the effluent to the OID Canal, but discharge to the E/P ponds may occur if operational constraints warrant.

Capital costs for Option A of this alternative include extraction wells. Capital costs for Option B of this alternative include the construction of extraction wells, the conversion of existing wells, and the installation of piping, pumps, tanks, ion exchange and filtration units, and other associated equipment. Also included are monitoring requirements for the system. Tables 2-11 and 2-13 present the capital costs associated with this alternative for Option A and Option B, respectively. The overall capital cost is estimated at $103,500 for Option A, and $1,321,000 for Option B.

Operations and maintenance (O&M) costs for this alternative include labor, utilities, chemical requirements, monitoring of influent, effluent, and groundwater conditions, disposal costs, and other associated items. Tables 2-12 and 2-14 present the O&M costs for Options A and B, which are estimated at $797,000 and $953,000 per year, respectively.

The present worth costs have been developed for each option based on a 10-year system operation. The total present worth of Option A is $6,454,000, and the total present worth of Option B is $8,734,000.

The selected groundwater remedy will meet the following remediation goals:

- Extraction of groundwater until chromium concentrations are less than the state MCL of 50 μg/L for chromium.
- Extraction of groundwater until cyanide concentrations are less than the federal MCL of 200 μg/L for cyanide.

2.16.2 Landfill Remedy

Based on CERCLA requirements, the Dispute Resolution Agreement, the detailed analysis of alternatives, and public comments, EPA, in consultation with CA EPA-DTSC, CA EPA-RWQCB, and the Army, has determined that Alternative 3: Final Cover, is the most appropriate remedy for landfill remediation at RBAAP. This remedy was selected based on the provisions set forth in the DRA. For reference purposes, the entire text of the DRA is included in Appendix A.

Table 2-11

Estimate of Capital Costs for Alternative 3: Increased Extraction With Treatment in the IGWTS and IWTP (Option A)

Item	Description	Quantity	Cost/Year ($)
1.	Extraction Wells	4	50,000
2.	New Surge Tank	1	10,000
3.	Piping Tie-Ins	1 LS	5,000
4.	Pumps	2	10,000
Subtotal			75,000
Engineering and Construction Services		20%	15,000
Subtotal			90,000
Contingency (@ 15%)		15%	13,500
Total (Rounded)			103,500

Table 2-12

Estimate of O&M Costs for Alternative 3: Increased Extraction With Treatment in the IGWTS and IWTP (Option A)

Item	Description	Cost/Year ($)
1.	Labor	162,440
2.	Material Includes: Chemical Requirements, Analytical Equipment, Expendables, etc.	140,000
3.	Overhead Includes: Utility Costs, Service Fees, etc.	208,000
4.	General and Administrative	34,520
5.	Monitoring of Groundwater	147,670
Subtotal		692,630
Contingency		103,895
Total (Rounded)		797,000

Table 2-13

Estimate of Capital Costs for Alternative 3: Increased Extraction With Treatment in the IGWTS and IWTP (Option B)

Item	Description	Quantity	Cost/Year ($)
1.	New Reduction/Precipitation Unit	1	260,000
2.	New Anion Exchange Unit	1	300,000
3.	Sitework and Building Expansion		102,000
4.	Piping/Controls/Electrical		180,000
5.	Extraction Wells	4	50,000
6.	Modify Existing Wells	8	40,000
7.	New Surge Tank		10,000
8.	Piping Tie-Ins		5,000
9.	Pumps		10,000
Subtotal			957,000
Engineering and Construction Services		20%	191,400
Subtotal			1,148,400
Contingency (@ 15%)		15%	172,600
Total (Rounded)			1,321,000

Table 2-14

Estimate of O&M Costs for Alternative 3: Increased Extraction With Treatment in the IGWTS and IWTP (Option B)

Item	Description	Cost/Year ($)
1.	Labor	162,440
2.	Material Includes: Chemical Requirements, Analytical Equipment, Expendables, etc.	196,000
3.	Overhead Includes: Utility Costs, Service Fees, etc.	288,000
4.	General and Administrative	34,520
5.	Monitoring of Groundwater	147,670
Subtotal		828,630
Contingency (@ 15%)		124,295
Total (Rounded)		953,000

According to the DRA, the Army agreed to: 1) install a final cover, using to the extent possible soils from the installation to reduce capital costs; 2) maintain the final cover for a period of 20 years; and 3) install additional monitor wells downgradient of the landfill. The 5-year review process under CERCLA, and as described in the RBAAP FFA, will be used to evaluate if continued maintenance of the cover is necessary to protect human health and the environmental, including water quality.

Under the DRA, the parties agree to the substantive requirements of Title 23 CCR, Chapter 15, Articles 5 and 8, Corrective Action and Closure Requirements. Based on the discussion during the Dispute Resolution process, the parties agreed that this alternative for the landfill will be incorporated as the recommended landfill remedy. In order to resolve the dispute, the parties agreed to the language below, without making a determination as to whether Chapter 15 is an ARAR. The following specifics were agreed to:

- A foundation soil layer of sufficient stability will be provided by grading and compacting existing landfill soils.
- A 1-ft-thick layer will be installed consisting primarily of clays from a clean source on the installation. The clay source will be supplemented, as necessary, by off-site clays to produce a clay layer with design permeability of 1×10^{-6} cm/sec.
- Geotechnical data will be collected from a clean source at the installation to determine the appropriate ratio of on-site to off-site clays to achieve a design permeability of 1×10^{-6} cm/sec.
- A minimum of 1 ft of clean topsoil will be placed over the clay layer to provide an adequate rooting depth for vegetative cover and protection of the clay layer.
- The final cover will be designed with the objective of minimizing maintenance.
- The final cover will be graded to provide a minimum of 2% slope to minimize ponding of precipitation and provide adequate drainage.
- The final cover will be constructed in accordance with an approved CQAP.

- The final cover will be maintained to ensure its integrity for a period of 20 years.

- A 5-year review process will be used to evaluate whether continued maintenance of the cover is necessary to protect human health and the environment, including water quality.

- One to two additional monitor wells will be installed downgradient of the landfill at the point of compliance.

Installation of the final cover on the landfill also addresses the risks presented by elevated arsenic levels in the soils under a hypothetical future residential use scenario. However, since the soils will remain in place at the landfill, access and deed restrictions will also be implemented for the landfill area. These restrictions will prevent exposure to the landfill soils after the final cover maintenance period has ended.

The final cover on the landfill will prevent exposure to the arsenic in the landfill soils in addition to preventing exposure to the pot liner material (which contains cyanide).

Capital costs for the final cover of the landfill include site preparation, placement of cover layers, revegetation, installation of a maximum of two monitor wells, and other associated items. Table 2-15 presents the capital costs, which are estimated at $354,190.

The O&M costs involve grounds keeping and erosion control at the landfill. Table 2-16 presents the O&M costs, which are estimated at $4,400 annually.

The total present worth cost for the capping of the landfill is $404,690, based on a 20-year maintenance of the cap.

The selected landfill remedy will meet the requirements set forth in the DRA dated February 1993.

Table 2-15

Estimate of Capital Costs for the Landfill Final Cover

Item	Description	Quantity	Cost ($)
1	Site Preparation	21,300 yd^2	19,675
2	Obtain On-Site Clay/Geotechnical Testing	6,000 yd^3	41,900
3	Obtain Off-Site Clay to Mixing Site	1,560 yd^3	23,166
4	Mix Clay	7,560 yd^3	49,000
5	Transport Clay Mix to Site	15 days	12,000
6	Restore On-Site Excavation Area	3,000 yd^3	26,400
7	Place Clay on Landfill	7,560 yd^3	6,400
8	Obtain/Place Clean Topsoil on Landfill	7,800 yd^3	66,400
9	Grade, Seed, and Survey Site	192,000 ft^2	11,850
10	Install Monitor Wells	Two wells	15,400
11	Mobilization/Demobilization of Staff	Event	74,500
12	E&S Control	3,000 linear ft	7,500
	Total Construction Services		354,190

Table 2-16

Estimate of O&M Costs for the Landfill Final Cover

Item	Description	Cost/Year ($)
1	Grounds Keeping	1,000
2	Erosion Control	3,000
	Subtotal	4,000
	Contingency - 10%	400
	Total	4,400
	Present Worth - 20 Years (Rounded)	50,500

2.17 STATUTORY DETERMINATIONS

The selected remedies satisfy the requirements under Section 121 of CERCLA to:

- Be protective of human health and the environment.
- Comply with ARARs.
- Be cost-effective.
- Use permanent solutions and alternative technologies or resource recovery technologies to the maximum extent practical.
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element OR provide an explanation as to why this preference is not satisfied.

Because the remedies will result in groundwater contamination remaining on-site above the remedial goals (MCLs) for the duration of the remedial efforts and the landfill cover is required to be maintained for 20 years, a review will be conducted within 5 years after commencement of the remedial action. The 5-year review will ensure that the remedies continue to provide adequate protection of human health and the environment.

A brief description of how the remedies satisfy each of the statutory requirements is presented below.

2.17.1 Protection of Human Health and the Environment

The groundwater remedy, using pump and treat technologies, will protect human health and the environment by extracting groundwater above remediation goals in all affected aquifer zones and treating the groundwater after extraction. The extraction of the groundwater will reduce the carcinogenic and noncarcinogenic risks due to the chromium and cyanide in the groundwater to acceptable levels as outlined by the MCLs for the contaminants. The treatment will be performed to meet effluent discharge requirements to the OID Canal and the E/P ponds, which were established by RWQCB and are adopted in this ROD to be less than 50 μg/L for chromium and 5.2 μg/L for cyanide for the E/P ponds and 11 μg/L for chromium and 5.2 μg/L for cyanide for the OID Canal. Engineering controls, such as safe construction practices and dust control measures, will be used to minimize short-term risks related to the construction of wells.

The presence of a final cover and groundwater monitoring to ensure the effectiveness of the cover will provide adequate protection from the residual levels of chromium left in the landfill soils. The cover will also address the risks presented by the elevated arsenic levels in the soils under a hypothetical future residential use scenario. Access and deed restrictions will be used to prevent exposure to the landfill materials.

Using engineering and administrative controls (i.e., dust suppression, erosion control, etc.), no unacceptable short-term risks or cross-media impacts will be caused by implementation of the remedies.

2.17.2 Compliance With ARARs

Both the groundwater and landfill remedies address all of the ARARs outlined in Subsection 2.6 of this ROD.

2.17.3 Cost-Effectiveness

The selected remedies afford overall effectiveness proportionate to their costs. The groundwater remedy is more protective than Groundwater Alternatives 1 and 2, and is less expensive than Groundwater Alternative 4. Pump and treat for groundwater is a well-proven technology that can achieve the remediation goals. Since Groundwater Alternatives 1 and 2 do not address all of the groundwater contamination beneath the site, the groundwater remedy provides added protection of human health and the environment, which justifies the incremental cost incurred.

The landfill remedy is the most protective landfill alternative for the cost incurred. Landfill Alternatives 1 and 2 do not provide adequate protection of human health and the environment. The landfill remedy provides protection at a significantly lower overall cost than Landfill Alternative 2.

2.17.4 Use of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practical (MEP)

The selected remedies are permanent solutions that provide the best balance of tradeoffs among the respective alternatives evaluated with respect to the primary balancing criteria. The criteria that were most critical in the selection decision for the groundwater remedy were long-term effectiveness and permanence and implementability. In Groundwater Alternative 3, the groundwater containing contaminants above remediation goals will be captured and treated to meet effluent disposal requirements to the OID Canal and the E/P ponds. In addition, the remedy uses an existing treatment system for groundwater treatment, thereby requiring minimal construction for implementation of this alternative. Therefore, Groundwater Alternative 3 uses a permanent solution to address the groundwater contamination at the site.

The landfill remedy was selected due to agreements made under the DRA and addresses the potential impact of chromium-contaminated soils on groundwater beneath the landfill. This is the decision basis for the selection of Landfill Alternative 3. Although this remedy does not address treatment of the soil as a preferred method, it would be performed in accordance with substantive requirements of Title 23, CCR Division 3, Chapter 15, as outlined in the DRA, and would reduce the mobility of the contaminants in the landfill. Installation of the final cover on the landfill also addresses the risks presented by elevated arsenic levels in the soils under a hypothetical future residential use scenario.

The tradeoffs among the respective alternatives with respect to the five balancing criteria are highlighted as follows:

- **Long-Term Effectiveness and Permanence.** A reduction in the inherent hazards posed by chromium and cyanide in the groundwater would occur through implementation of Groundwater Alternatives 3 or 4. The groundwater will be treated to a level to ensure protectiveness of the receiving streams (i.e., the OID Canal and E/P ponds). A groundwater monitoring program would be in place to assess the effectiveness of the preferred alternative and an annual review of the system will be performed. Groundwater monitoring will occur for 5 years after the extraction and treatment system stops operating to determine whether concentrations of contaminants stay below the remediation goals. Wastes generated during groundwater treatment will be permitted. Therefore, no long-term risks from these wastes are expected.

  The preferred landfill alternative will serve to ensure that no further impact to groundwater occurs as a result of migration of chromium in the landfill soils. Landfill Alternative 1 does not prevent chromium migration from the landfill, and Landfill Alternative 2 prevents risks from the pot liner material only. The containment provided by Landfill Alternative 3 provides a source control measure for the landfill. Installation of a final cover on the landfill also addresses the risks presented by elevated arsenic levels in the soils under a hypothetical future residential use scenario.

- **Reduction of Toxicity, Mobility, or Volume of the Contaminants Through Treatment.** Groundwater Alternatives 3 and 4 would treat the wastes to reduce the toxicity, mobility, or volume of the contaminants (chromium and cyanide). The extraction of groundwater should reduce the mobility of the contaminants in the groundwater prior to treatment.

  Only Landfill Alternative 2 would use treatment to reduce the toxicity and mobility of contaminants, specifically the pot liner material. The preferred landfill alterative would cover the landfill soils, but does not address treatment of the soils as a preferred method.

- **Short-Term Effectiveness.** Both Groundwater Alternatives 3 and 4 would capture the groundwater and reduce the risk of human exposure as much as practical. Groundwater Alternative 3, the preferred alternative, has less short-term risk than Groundwater Alternative 4 because limited construction activities are required.

  Quarterly groundwater monitoring will be performed throughout the operation of either treatment system to determine the effectiveness of the system.

  Landfill Alternatives 2 and 3 would involve short-term risks due to earth-moving activities at the landfill. An on-site air monitoring program would be established to monitor air quality during these activities. In addition, adequate safety practices will be used to deal with the construction hazards related to these alternatives.

- **Implementability.** The preferred groundwater alternative will use the existing IGWTS and IWTP for operation, with modifications. This will be much easier to perform than Groundwater Alternative 4, which requires the construction of a new treatment system to treat the extracted groundwater.

  There are relatively few administrative difficulties associated with each alternative. The remedies have been used extensively to address similar contaminants at other Superfund sites.

  Each of the landfill alternatives would have few associated technical or administrative difficulties that would deter implementation. Landfill Alternative 1 requires only access and deed restrictions to be placed on the landfill. Landfill Alternatives 2 and 3 would employ conventional construction and engineering practices. The preferred landfill alternative would require a 20-year maintenance period; the other alternatives would not require maintenance.

- **Cost.** The present worth cost for the preferred groundwater alternative is $6,454,000 (Option A). The lowest-cost alternative is Groundwater Alternative 1 at $2,338,000. The highest-cost alternative is Groundwater Alternative 4 at $11,850,000 (Option B). Groundwater Alternative 2 has a present worth cost of $5,737,000.

  The present worth cost for the preferred landfill alternative is $405,000. Landfill Alternative 1 does not have any cost associated with it, whereas Landfill Alternative 2 has a present worth cost of $508,000.

The two modifying criteria of state acceptance and community acceptance are discussed below.

State Acceptance:

CA EPA-DTSC and CA EPA-RWQCB have responded favorably to the selection of the following alternatives:

- Groundwater Alternative 3: Increased Extraction With Treatment at the IGWTS and IWTP, with treated groundwater discharge to the OID Canal (preferred discharge location) and the E/P ponds.

- Landfill Alternative 3: Final Cover.

Community Acceptance

The public reaction to the selected groundwater remedy was generally favorable. The major concerns of the community included the placement of extraction wells off-site and the operation of the extraction system. The concerns were mainly aesthetic and do not affect the selection of the groundwater remedy.

No public comments were directly related to the selection of the landfill remedy.

2.17.5 Preference for Treatment as a Principal Element

The statutory preference for treatment is satisfied by the groundwater remedy since treatment is a primary component by which the groundwater contaminants are removed. The selected groundwater alternatives would use chemical reduction and ion exchange to treat the chromium- and cyanide-contaminated groundwater to below the remediation goals.

The landfill remedy, Alternative 3: Final Cover, does not satisfy the statutory preference for treatment as a principal element since treatment of the principal threats at the landfill was not found to be practical, and therefore is not included. The nature of the soil contamination at the landfill precludes a remedy in which the contaminants could be excavated and treated in a cost-effective manner.

2.18 DOCUMENTATION OF SIGNIFICANT CHANGES

The following selected remedies were presented to the public during the public meeting and the public comment period via the Proposed Plan:

- Groundwater Alternative 3: Increased Extraction With Treatment at the IGWTS and IWTP, with treated groundwater discharge to the OID Canal (preferred discharge location) and the E/P ponds.
- Landfill Alternative 3: Final Cover.

The EPA, CA EPA, and the Army reviewed all verbal comments submitted during the public comment period (no written comments were submitted). Upon review of the comments, it was determined that no significant changes to the preferred remedies outlined in the Proposed Plan were necessary.

2.19 POST-ROD ACTIONS

The following subsections outline issues that may need to be addressed based on events that may occur after approval and implementation of this ROD.

2.19.1 Recharge of the A Aquifer Zone

As discussed in Subsection 2.7.2, the A aquifer zone has dewatered over the course of RIs at RBAAP. The Army has concluded that this zone potentially has trapped chromium and cyanide contaminants that could once again contaminate the groundwater if the A aquifer zone recharges in the future. The Army will continue to monitor the A aquifer zone to determine if the aquifer recharges, and will investigate and remediate the groundwater according to the ARARs and the remediation goals established in this ROD, if necessary.

2.19.2 IWTP Source Investigation Upon Base Closure

The IWTP area was identified as a source of chromium contamination in the groundwater. Investigations conducted around the current IWTP tanks determined that no threat to groundwater exists from residual contamination in the soils investigated. However, because the IWTP is an operational system, investigations were limited to the perimeter of the tanks and did not evaluate soil contamination directly below the tanks. Under the current RCRA permit, the Army is required to investigate this site upon closure to ensure that impacts or potential impacts to the environment are mitigated. Further investigation of this area will be conducted upon closure in accordance with RCRA closure requirements.

SECTION 3
RESPONSIVENESS SUMMARY

The final component of the ROD is the Responsiveness Summary, which serves two purposes. First, it provides lead agency decision-makers (in this instance, the Army) with information about community preferences regarding both the remedial alternatives and general concerns about the site. Second, it demonstrates to members of the public how their comments were taken into account as an integral part of the decision-making process.

3.1 OVERVIEW

In compliance with the public participation requirements of CERCLA/SARA (Section 113(k)(2)(B)(i-v)), the Army held a public comment period from 27 August 1993 to 27 September 1993 and a public meeting on 31 August 1993 for interested parties to comment on the proposed plan for remediating the groundwater and the landfill at RBAAP. EPA, in consultation with CA EPA and the Army, had selected the preferred alternatives for RBAAP and presented these alternatives in the proposed plan. The recommended groundwater remedy is increased extraction of groundwater with treatment at the Interim Groundwater Treatment System (IGWTS) and at the facility's Industrial Waste Treatment Plant (IWTP). The recommended landfill alternative is the placement of a final cover on the landfill.

The public reaction to the preferred alternatives was generally favorable; therefore, no change to the preferred alternatives is warranted based on community acceptance. The main concerns of the community include the placement of extraction wells off-site and the operation of the extraction system. These issues were addressed during the public meeting on 31 August 1993, and the Army and regulatory agencies provided verbal responses to public questions and comments. The Army will continue to hold community relations activities to increase public awareness of the RBAAP remediation activities. This ROD will be processed in accordance with the California Environmental Quality Act, including public review.

3.2 BACKGROUND ON COMMUNITY INVOLVEMENT

Community involvement history of RBAAP has centered on formal community interviews conducted to assess opinions and concerns of adjacent property owners and area residents about RBAAP environmental studies and remedial actions; press releases to public media; the off-site well sampling program; ongoing informal interviews and discussions with adjacent property owners; and Army-sponsored public meetings.

At various times since September 1985, formal news releases have been issued by RBAAP concerning the groundwater contamination problem. The timing of these releases has generally coincided with the quarterly off-post monitoring program, the availability of significant results from on-post and off-post investigative efforts, and the availability of documents related to removal actions for public review. The releases have provided the local media and the general public with information on the status and results of the contamination surveys, ongoing actions to protect public health, and plans and schedules for additional activities.

Community involvement activities regarding the RBAAP contamination problem have also involved direct contact and communication with local property owners and residents in conjunction with the off-site domestic well sampling program, which was initiated in the area west of the facility in September 1985. Residents within the off-site sampling area receive water sampling reports and letters informing them of updates in RBAAP environmental studies and notices of public meetings.

Since September 1985, several public meetings have been conducted, initially to inform the public of the contamination problem discovered at RBAAP and its possible impacts on the residences west of the facility, then to update them on the progress of environmental investigations and to solicit input on proposed removal and remedial actions. A summary of public meetings and interviews is provided in Table 3-1.

Table 3-1

Public Meetings and Interviews Conducted at RBAAP

RBAAP conducted a public meeting to discuss the results of the first round of sampling of the residential wells west of the facility (November 1985).
RBAAP conducted a public meeting to discuss the results of the second round of the residential well sampling program (March 1986).
RBAAP conducted a public meting to discuss the results of the third round of the residential well sampling program (June 1986).
RBAAP, with assistance from the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Public Affairs Office (PAO), conducted a door-to-door community survey of property owners and residents in the area adjacent to RBAAP where residential wells were being sampled by the Army (July 1986).
RBAAP conducted a public meeting to discuss the results of the fourth round of the residential well sampling program (September 1986).
RBAAP and USATHAMA PAO conducted a public meeting to update the public on the residential well sampling program and on remedial investigations (RIs) (August 1987).
RBAAP and USATHAMA PAO conducted a reassessment survey of public concerns and opinions regarding RBAAP environmental studies (8 to 10 August 1989).
RBAAP, USATHAMA, EPA, and California DTSC and RWQCB conducted a public meeting in conjunction with the public review and comment period on the proposed installation of the IGWTS (December 1989).
RBAAP, USATHAMA, EPA, and California DTSC and RWQCB conducted a public meeting in conjunction with the public review and comment period on the proposed installation of a waterline to replace domestic wells threatened by contaminated groundwater (June 1991).
RBAAP conducted a public ribbon-cutting ceremony for the waterline (December 1992).
RBAAP, U.S. Army Environmental Center (USAEC, formerly USATHAMA), EPA, and CA EPA (DTSC and RWQCB) conducted a public meeting in conjunction with the public review and comment period on the proposed removal action for the RBAAP E/P ponds (June 1993).
RBAAP, USAEC, EPA, and CA EPA (DTSC and RWQCB) conducted a public meeting in conjunction with the public review and comment period on the sitewide proposed plan for RBAAP (August 1993).

The public comment period on the proposed plan was held from 27 August to 27 September 1993. Notice of the public comment period and public meeting for the RBAAP remedial actions was placed in the Riverbank News and the Modesto Bee on 27 August 1993. The public meeting was held on 31 August 1993 at the Riverbank Community Center and was well-attended (approximately 20 people). Public questions raised primarily involved information concerning implementation of the selected groundwater alternative and contamination found at the site. No written or verbal comments concerning proposed remediation activities at RBAAP other than those presented at the public meting were received during the public comment period.

3.3 SUMMARY OF PUBLIC COMMENTS AND ARMY/EPA/CA EPA RESPONSES

At the public meeting held on 31 August 1993, the public was encouraged to comment and ask questions on the Proposed Plan. The following is a summary of the significant questions/comments raised by the public and the responses of the Army, EPA, and/or CA EPA.

Comment 1:

One commenter asked what type of pumps will be used in the extraction wells and how long they will operate.

Response 1:

The extraction well pumps will be electric pumps (maximum pump rate approximately 40 gallons per minute (gpm)) operating 24 hours per day. The pumps will continue to extract groundwater until the remedial objectives (50 parts per billion (ppb) for chromium and 200 ppb for cyanide) are met. The current estimate to meet these objectives is 10 years.

Comment 2:

One commenter asked where the off-site extraction wells will be placed and how the wells will be constructed. He was concerned about some of these extraction wells being placed on or near his property.

Response 2:

The locations of off-site extraction wells will be determined during the remedial design. The proposed locations presented during the public meeting were generated using the site groundwater model; final placement of wells will be based on field data and community concerns. The Army will make every attempt to place the off-site extraction wells along roadway easements to limit encroachment onto the residents' properties.

The extraction wells will be installed below grade, with traffic covers to provide as little disruption as possible to the existing natural condition.

Comment 3:

One commenter questioned the apparent increase of the chromium plume off-site over the last 5 years, especially during operation of the IGWTS.

Response 3:

The perceived increase in the chromium plume off-site is due to a number of reasons, including:

- The dewatering of the upper aquifer in the area has provided an avenue for plume movement off-site.
- Additional monitor wells off-site have provided better plume definition in the area.

Also discussed was the fact that the IGWTS has not been operating continuously since its startup in October 1991. Therefore, the IGWTS is not providing a complete capture of plumes in the B and C aquifer zones. The IGWTS does not extract groundwater from the A′ aquifer zone.

The recommended groundwater remedy will be designed to capture all of the contaminant plumes on-site and off-site.

Comment 4:

One commenter asked what the difference was between Groundwater Alternative 3 and Groundwater Alternative 4.

Response 4:

Both Groundwater Alternatives 3 and 4 involve increased extraction of groundwater to capture the on-site and off-site chromium and cyanide plumes. The extraction system is the same for both alternatives. The difference in these alternatives is that Alternative 3 uses the existing treatment system for treatment of extracted groundwater. Alternative 4 involves the construction of a new treatment system for extracted groundwater treatment.

The Army stated that the existing system treats the groundwater to regulatory standards; therefore, under Alternative 3, a new treatment system is not necessary.

Comment 5:

One commenter requested that the Army send him data on the monitor wells on his property (monitor well cluster MW-105). He was concerned that, although his residential well was not contaminated, nearby monitor well MW-105B did show contamination.

Response 5:

It was explained that the domestic wells are screened through multiple aquifer zones; therefore, the dilution from the aquifer zones reduces the potential for concentrations above regulatory standards.

However, the Army will provide data to the residents on off-site monitor wells as well as data on individual residential wells.

Comment 6:

One commenter suggested that the surface waters southwest of RBAAP (Modesto Irrigation Canal, surface ponds) be sampled to determine if groundwater contamination may be contributing to surface water contamination.

Response 6:

The groundwater in the area is approximately 60 ft below ground surface (bgs), and no springs exist in the area. Therefore, there is no anticipated interaction between groundwater and surface water in the study area.

Comment 7:

One commenter questioned the Army's intent in not performing additional action for removal of the residual pot liner at the RBAAP landfill.

Response 7:

The Army indicated that the majority of the pot liner material disposed at the landfill was already removed during a prior removal action, and that only residual fragments are remaining. Per federal regulation, those fragments are not considered hazardous waste until they are excavated, and per the results of groundwater sampling, the fragments have not proven to be a continuing source of contamination. Due to the extreme difficulty that would be involved in locating, screening, and excavating such small fragments, and due to the fact that contamination no longer appears to be originating from that potential sources, the Army does not plan to excavate the remaining pot liner material. In addition, the final cover to be installed will eliminate any potential exposure to the fragments. The federal and state regulatory agencies have concurred with the Army.

APPENDIX A

RBAAP DISPUTE RESOLUTION AGREEMENT

DEPARTMENT OF THE ARMY
RIVERBANK ARMY AMMUNITION PLANT
RIVERBANK, CALIFORNIA 95367-0670

REPLY TO
ATTENTION OF:

February 26, 1993

SMCRB-CR

Ms. Julie Anderson
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Anderson:

The enclosed document as prepared by this office provides for a mutually acceptable resolution of the dispute raised by the Regional Water Quality Control Board.

It is requested that your signature be affixed to the document to reflect your official acceptance.

Finally, in accordance with the Riverbank Army Ammunition Plant Federal Facility Agreement effective February 26, 1993, this dispute is considered resolved pursuant to Section 12.11 of the above document. Therefore, within 21 days, a Final Draft Feasibility Study will be provided to the parties for consideration.

If you have any further questions, please contact me at your earliest convenience at (209) 529-8100, extension 239.

FOR THE COMMANDER:

Sincerely,

James E. Gansel
Commander's Representative

Enclosure

Copies Furnished:

Commander, Hawthorne AAP, SMCHW-CO, Hawthorne, NV (w/encl)
Commander, U. S. Army Environmental Center, ATTN: CEHA-IR-A (J. Daniel), Aberdeen Proving Ground, MD 21010-5401 (w/encl)
Commander, U. S. Army Armament, Munitions and Chemical Command, (Dr. Henry Crain), Rock Island, IL 61299-6000 (w/encl)
Mr. Jim Pinasco, California EPA, Department of Toxic Substances Control, 10151 Croydon Way, Suite 3, Sacramento, CA 95827-2106 (w/encl)
Mr. Robert Reeves, California Regional Water Quality Control Board, 3443 Routier Road, Suite A, Sacramento, CA 95827-3098 (w/encl)

Riverbank Army Ammunition Plant (RBAAP)
Dispute Resolution Agreement

The Dispute Resolution Committee (DRC) met on 11 February 1993 to address the dispute on the Draft Final Feasibility Study (FS) Report for the RBAAP raised by the Central Valley Regional Water Quality Control Board (RWQCB) on 23 October 1992. This consensus statement documents agreements among the U.S. Army, the U.S. Environmental Protection Agency, Region IX (USEPA), the (RWQCB) and the Department of Toxic Substances Control (DTSC), Region 1. Resulting agreements will be fully documented in the Final FS Report. Upon approval of the Final FS Report, the dispute will be considered resolved.

RESOLUTION: The following agreements were reached during negotiations on 11 February 1993:

1. Landfill Issue: The Army agreed to install a final cover, utilizing to the extent possible soils from the installation to reduce capital costs, and to maintain the final cover for a period of 20 years and to install additional monitor wells. The five-year review process, under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and as described in the RBAAP Federal Facilities Agreement (FFA), will be used to evaluate if continued maintenance of the cover is necessary to protect human health and the environment, including water quality.

The parties agree to the substantive requirements of this resolution. These requirements were based on California Code of Regulations, Title 23, Chapter 15, Articles 5 and 8, Corrective Action and Closure Requirements. Based on the discussion during the Dispute Resolution process the parties agreed this alternative for the landfill to be incorporated into the FS Report as the recommended alternative and that the alternative be selected for the Proposed Plan and be reflected in the Draft Record of Decision (ROD). In order to resolve the dispute, the Parties have agreed to the language below, without making a determination as to whether Chapter 15 is an ARAR. The following specifics were agreed to:

a. A foundation soil layer of sufficient stability will be provided by grading and compaction of existing landfill soils.

b. A one-foot thick clay layer will be installed consisting primarily of clays from a clean source on the installation which will be supplemented as necessary, by offsite clays to produce a clay layer with a design permeability of $1x10^{-6}$ cm/sec.

c. Geotechnical data will be collected from a source at the installation to determine the appropriate ratio of onsite to offsite clays to achieve a design permeability of $1x10^{-6}$ cm/sec.

d. A minimum of one foot of clean top soil will be placed over the clay layer to provide an adequate rooting depth for vegetative cover and protection of the clay layer.

e. The final cover, as described above, will be designed with the objective of minimizing maintenance.

f. The final cover will be graded to provide a minimum of 2 percent slope to minimize ponding of precipitation and provide adequate drainage.

g. The final cover will be constructed in accordance with an approved construction quality assurance plan.

h. The final cover will be maintained to ensure its integrity for a period of 20 years.

i. The five year review process under RBAAP's FFA (CERCLA) will be used to evaluate if continued maintenance of the cover is necessary to protect human health and the environment, including water quality.

j. One or two additional monitoring wells will be installed at the point of compliance.

2. Ground Water Remedial Action Issue: The Army will install an extraction and treatment system that will provide full capture of the contaminated ground water plumes. The Army further agrees to provide quarterly and annual monitoring reports. The following specifics were agreed to:

a. The groundwater model will be calibrated using field data collected during operation of the Interim Remedial Measure (IRM). Further calibration efforts will be performed and reported to the agencies based on the existing data, prior to the Draft ROD.

b. Field data and the model will be used to aid in the design of the final extraction and treatment systems.

c. All field data collected since the IRM has been operational will be evaluated and submitted to the agencies prior to the Draft ROD.

d. The extraction system will be installed on-site and off-site if necessary to assure complete hydraulic capture of the chromium and cyanide plumes to the aquifer cleanup levels.

e. The treatment system capacity will be based on the flows necessary to fully capture the contamination plumes.

f. Domestic and Monitor Wells will continue to be monitored. A monitoring plan will be revised and submitted to the agencies for review. The reporting program will include quarterly reports and a comprehensive annual report.

g. Additional investigations and remediation will be conducted if the ground water monitoring program indicates the existence of unidentified source areas on the installation.

Signatures: The undersigned confirm the agreement as stated above.

David A. Hafele ------------------------------------ 26 FEB 93

David A. Hafele — DATE
Lieutenant Colonel, U.S.
Commanding
Riverbank Army Ammunition Plant

------------------------------------ ------------

Julie Anderson — DATE
U.S. Environmental Protection Agency
Region IX

Anthony J. Landis ------------------------------------ 2-26-93

Anthony Landis — DATE
California Environmental Protection Agency
Department of Toxic Substances Control

J. Lawrence Pearson ------------------------------------ 26 Feb 93

J., Lawrence Pearson — DATE
California Regional Water Quality Board
Central Valley Region

f. Domestic and Monitor Wells will continue to be monitored. A monitoring plan will be revised and submitted to the agencies for review. The reporting program will include quarterly reports and a comprehensive annual report.

g. Additional investigations and remediation will be conducted if the ground water monitoring program indicates the existence of unidentified source areas on the installation.

Signatures: The undersigned confirm the agreement as stated above.

------------------------------------ David A. Hafele Lieutenant Colonel, U.S. Commanding Riverbank Army Ammunition Plant	------------ DATE
JAnderson ------------------------------------ Julie Anderson U.S. Environmental Protection Agency Region IX	3-1-93 ------------ DATE
------------------------------------ Anthony Landis California Environmental Protection Agency Department of Toxic Substances Control	------------ DATE
------------------------------------ J. Lawrence Pearson California Regional Water Quality Board Central Valley Region	------------ DATE

APPENDIX B

HISTORY OF RBAAP PESTICIDE STORAGE AREA

November 10, 1993

SMCRB-CR

Mr. Ramon Mendoza
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Mr. Mendoza:

Enclosed is one copy of the drawing on the existing Pesticide Storage Facility as constructed. This facility complies with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regarding construction of the Pesticide Storage and Mixing Facilities.

For the previously addressed concerns on the operation of this facility, the following is appropriate:

(a) The original construction provided for the mixing sink to connect directly to a closed sump, as identified. While this was a "closed loop" connection, at no time was residual or pesticide laden water allowed to flow to the tank. In accordance with FIFRA requirements any pesticide laden water must be returned to the applicator tank for spraying.

(b) In 1980, it was recognized that since pesticide waste was not allowed to be discharged, then the mixing sink should be connected directly to the sanitary sewer. This resulted in elimination of the continual filling of the "closed loop" tank with rinse water.

(c) Again, the connection of the mixing sink fully complies with the requirements of the FIFRA regulations.

I trust this explanation and drawing closes the earlier addressed concern regarding this facility and its operation.

If you have any further questions, please contact Mr. James Gansel, (209) 529-8100, extension 239.

Sincerely,

SIGNED

James E. Gansel
Commander's Representative

Enclosure

Copies Furnished (w/encl):

Commander, Hawthorne AAP, SMCHW-CO (wo/encl)
Commander, U. S. Army Environmental Center, ATTN: ENAEC-IR-A (Mr. Jim Daniel), Aberdeen Proving Ground, MD 21010-5401
Commander, AMCCOM, AMSMC-EQE/Dr. Henry Crain, Rock Island, IL 61299-6000
Mr. Jim Pinasco, California EPA, Department of Toxic Substances Control, 10151 Croydon Way, Suite 3, Sacramento, CA 95827-2106
Mr. Robert Reeves, California Regional Water Quality Control Board, 3443 Routier Road, Suite A, Sacramento, CA 95827-3098

APPENDIX C

GROUNDWATER MODEL DEMONSTRATION - CHROMIUM AND CYANIDE CONCENTRATIONS VERSUS TIME

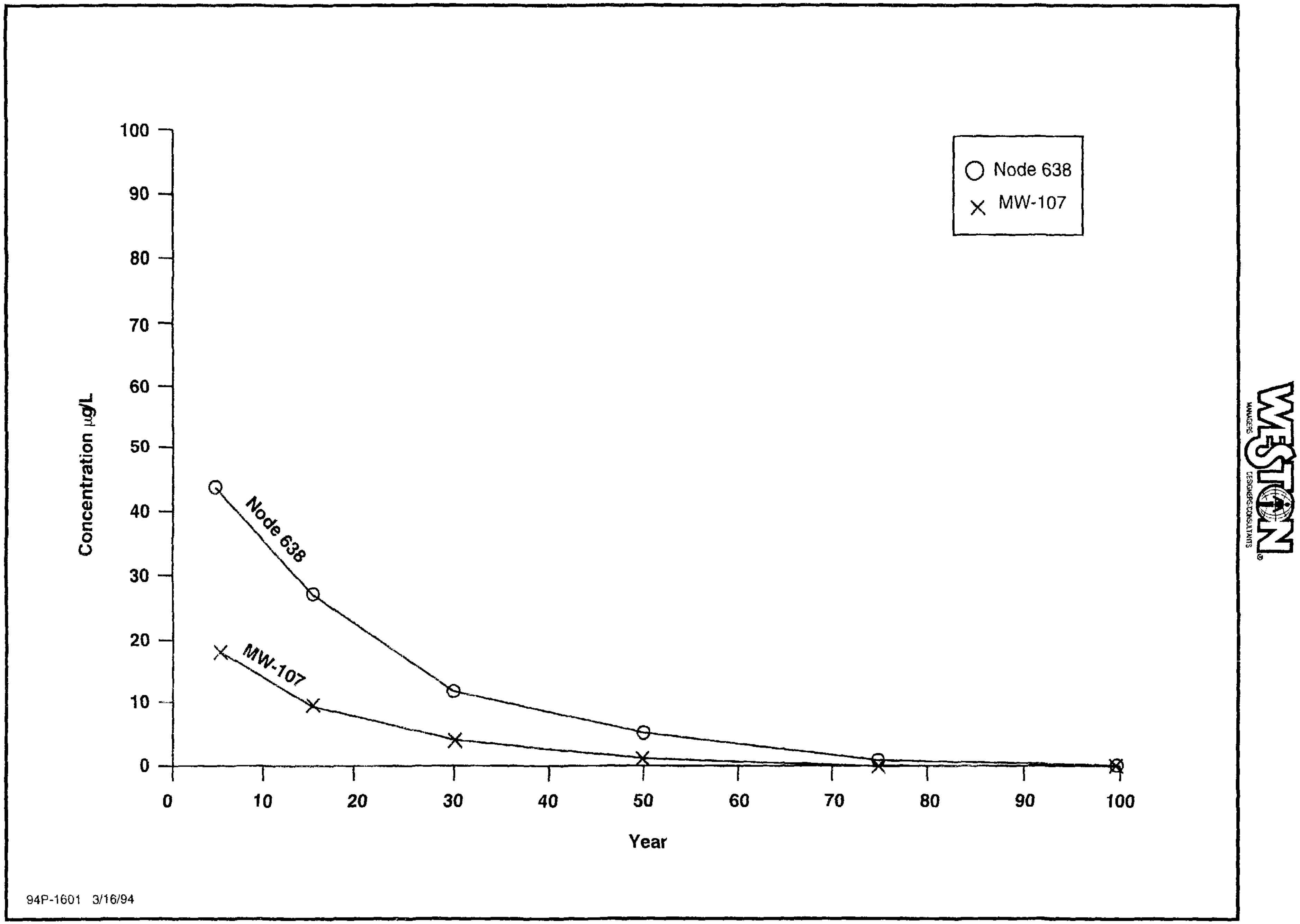
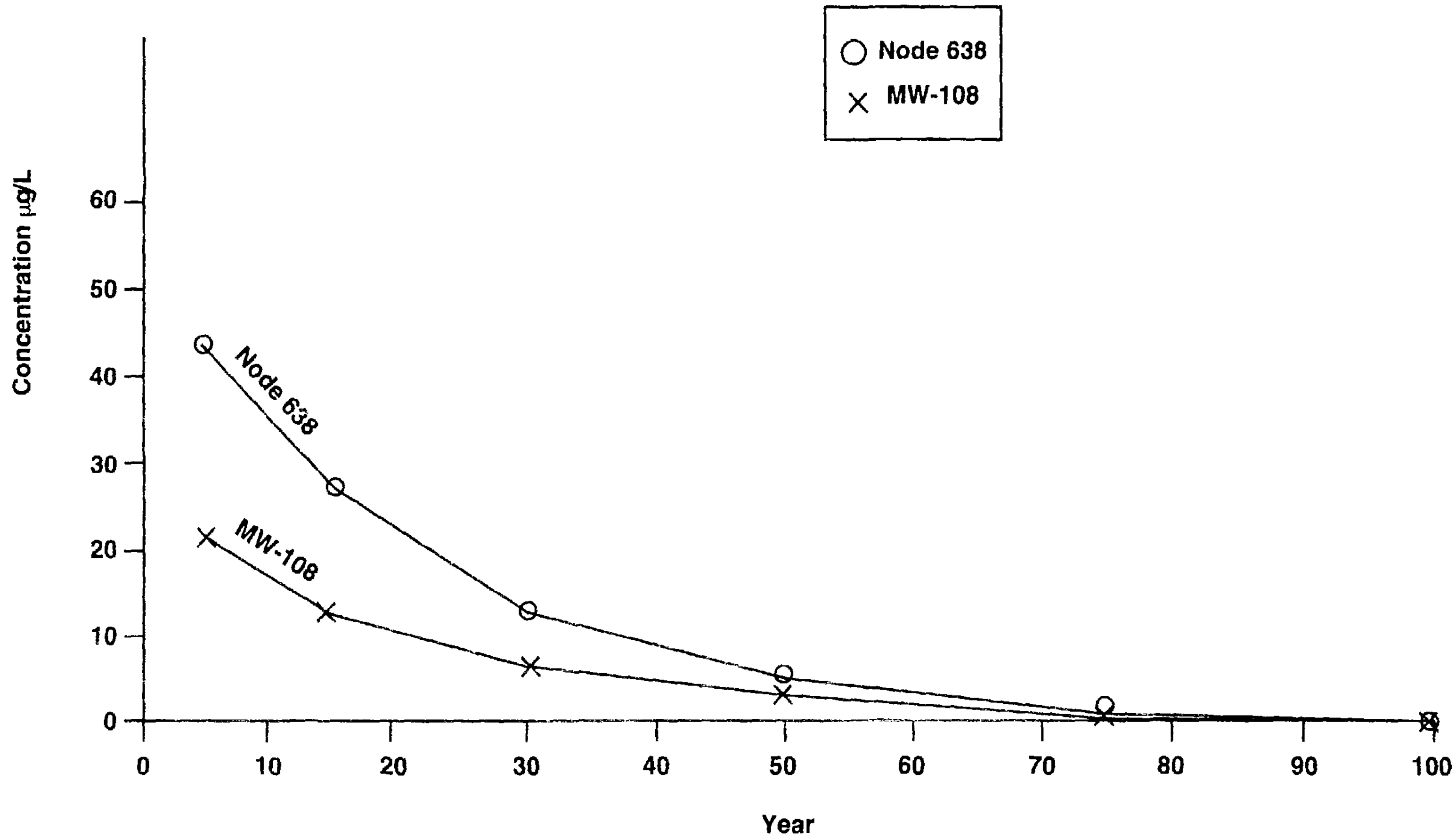
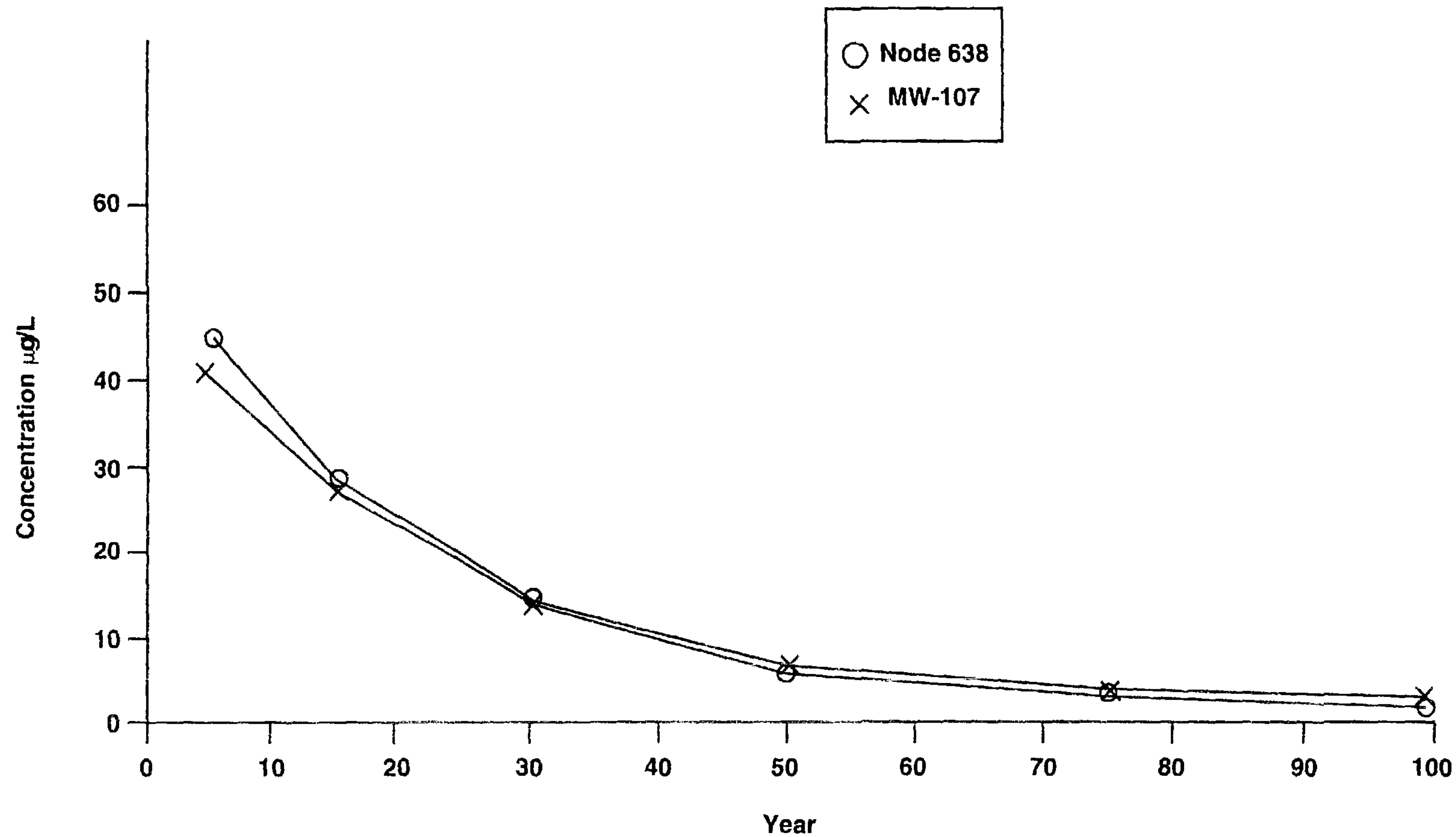


FIGURE C-1 A' AQUIFER ZONE-PLOT OF CHROMIUM CONCENTRATIONS VS. TIME USING THE CASE D PUMPING SCENARIO



94P-1602 4/16/94

FIGURE C-2 B AQUIFER ZONE-PLOT OF CHROMIUM CONCENTRATIONS VS. TIME USING THE CASE D PUMPING SCENARIO



94P-1603 3/16/94

FIGURE C-3 C AQUIFER ZONE - PLOT OF CHROMIUM ZONE CONCENTRATIONS VS. TIME USING THE CASE D PUMPING SCENARIO

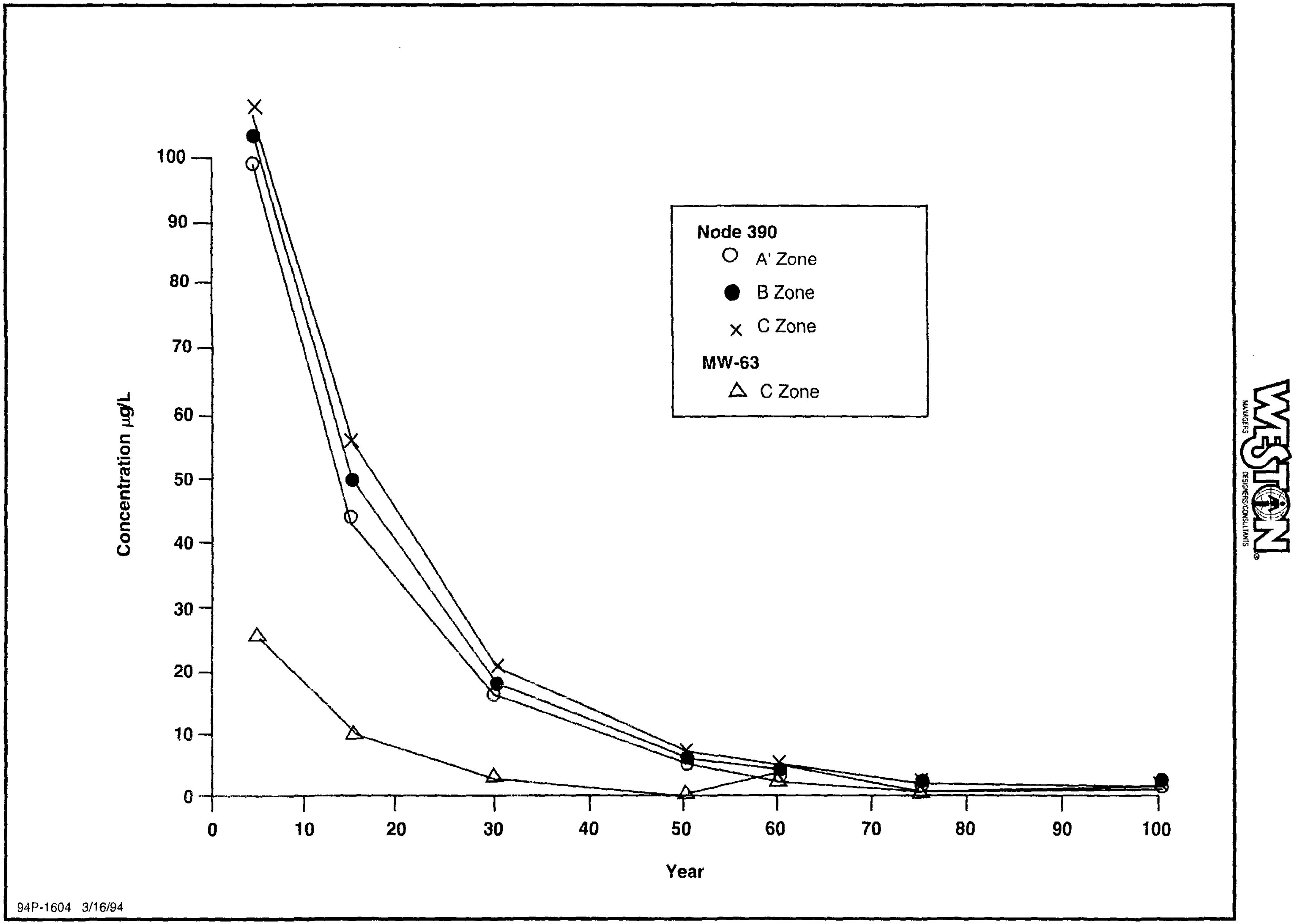


FIGURE C-4 A', B, AND C AQUIFER ZONES - PLOT OF CYANIDE CONCENTRATIONS VS. TIME USING THE CASE D PUMPING SCENARIO